ANALOG

SCIENCE FICTION AND FACT

JUNE 2001

Sunday Night Yams at Minnie and Earl's

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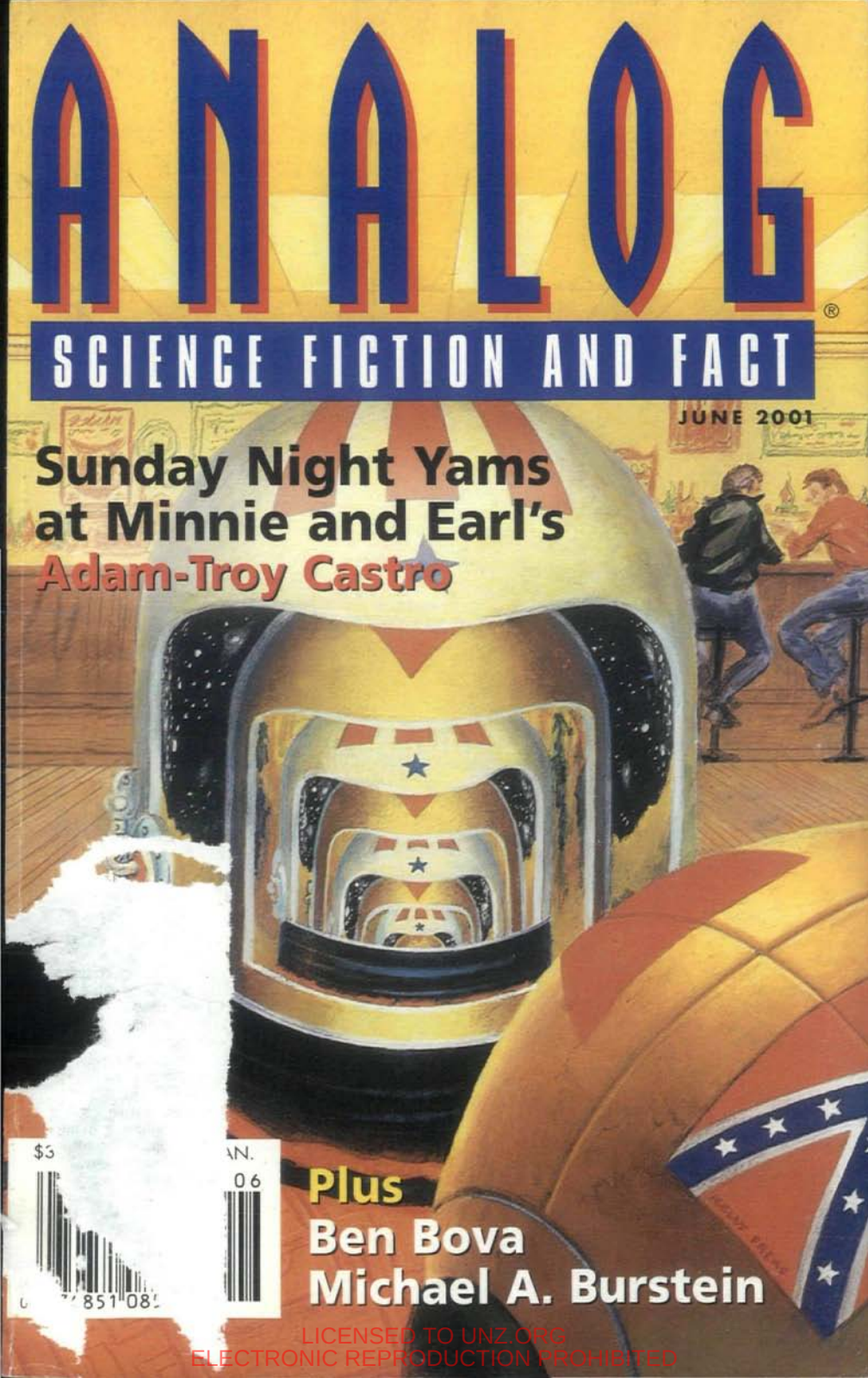

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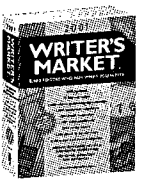

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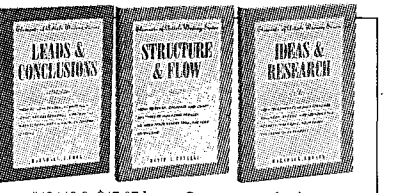

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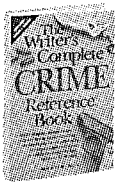

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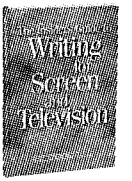

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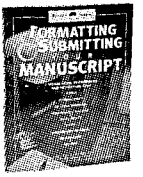

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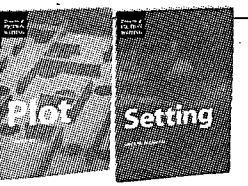

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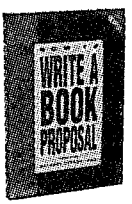

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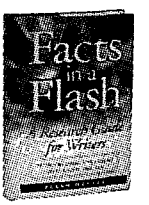

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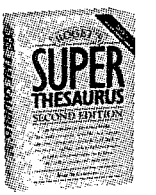

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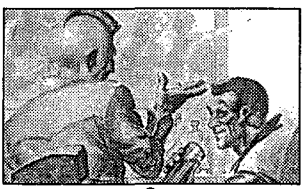

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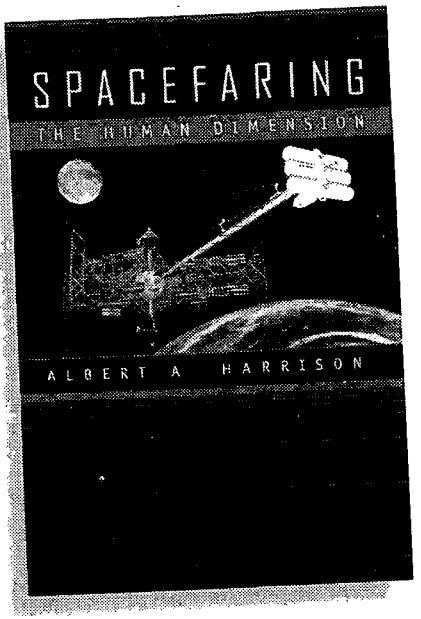

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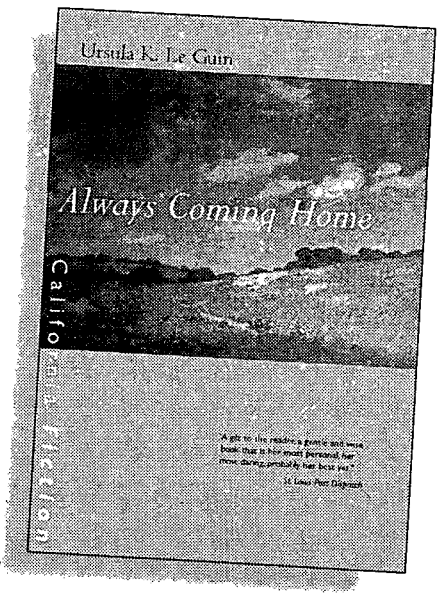

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ABOUT SCIENCE FICTION

Occasionally (not often) someone asks why the editorials in *Analog* are seldom about science fiction. The short, glib answer is: for the same reason why articles in microbiology journals are seldom about microscopes. A slightly less flippant answer is that *Analog* is a magazine *of* science fiction, not *about* science fiction, and its nonfictional parts are about the same kinds of things that science fiction is about.

Those answers are both true and appropriate, but the question is a legitimate one and deserves a more thoughtful, in-depth answer. A large part of that answer will involve an examination of the related question: what is science fiction about?

So this one *is*, at least in large part, about science fiction. (See? It says so right up there at the top.)

Science fiction is a complicated, wide-ranging, diverse thing. Its first function, at least as most of our readers and writers see it, is to entertain—that is, to provide an experience that readers find intellectually and/or emotionally satisfying on one or more levels. I'm always tempted to put this as succinctly as possible by saying it should be *fun*, but that tends to draw objections from serious-minded folk who think it implies frothy frivolity and rules out anything tragic or profound. I don't agree; I'm using words like "entertain," "enjoy," and "fun" in a very broad way that includes everything from Macbeth to the Marx Brothers. All I require is that the reader should be left with the feeling that the time spent reading a piece was well spent and rewarding. If in addition it's particularly thought-provoking or instructive, that's a bonus.

But this requirement by no means defines science fiction. It applies equally well to any literature or art (which I also define quite broadly). So what makes science fiction different from the others?

Its second main function, and the one that might well be viewed as defining it, is as a tool for examining the nature of the Universe and our place in it—with a special emphasis on how we got to be what we are and what we might become in the future. Science fiction writers, through their stories, explore such questions as: What kinds of worlds and lifeforms might exist out there? What kinds of new technologies might be invented by applying science as we know it? What kinds of science, not yet known to us, might be discovered in the future? How might all of these things affect the way people live in the future?

That last includes everything from such mundane details as how people will cook and travel and communicate, to how they will govern themselves, to how they will define right and wrong, to what role religion will play in their lives. Imagining new discoveries and new ways of doing things will suggest new practical, moral, ethical, and philosophical questions that real people will have to wrestle with, and find answers to, if those discoveries or inventions ever happen.

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Chances are that they won't happen in exactly the same way fiction writers envisioned them, but they may well happen in ways similar enough for the fictional "analog simulations" to be good practice for the real thing. Science fiction writers like to provide such exercises, partly because they know we will eventually need answers to such questions, and partly because they know that the kinds of people who read science fiction like to think about them, too. As former editor John W. Campbell put it (in what I believe was the only one of his 400 or so editorials that was about science fiction), "*Astounding* [*Analog*'s former name] has, throughout its history as a Street & Smith magazine, never pretended it was kidding, and has, for twenty years, been the non-escape literature that seeks to meet the problems of tomorrow in the only possible way—'git them before they git you!'"

We're still doing that—which is not, of course, to say that we're simply repeating what Campbell already did. We're always thinking of new problems and potentials, as one writer's thought suggests new angles to another, and real-world research forces us to consider new possibilities that nobody had thought of before.

People read this magazine primarily for fun, and secondarily—but very importantly—because they enjoy and realize the importance of thinking about both the potentials and the problems that lie ahead. It's hardly surprising that the writers of the nonfiction portions of the magazine—editorials, Alternate Views, and letters to the editor—explore those problems and potentials in their work, too. Quite often the fiction and nonfiction portions egg each other on. A story suggests the general form of an idea; an essay subsequently critiques it or suggests a specific way to make it happen. An essay may throw out an idea; a storyteller imagines what might happen to actual people if that idea became real.

And since our possible futures will necessarily evolve from our present circumstances, it's completely appropriate that people exploring ideas in our pages, whether through fiction or nonfiction, should sometimes look at things quite close to home. Not current events, exactly, in the sense of forecasting or commenting on the outcome of a particular election, policy decision, or other specific event. Our lead time is too long to be able to do that in a timely fashion; and in the long run, those fine details will not usually prove to have much cosmic significance anyway. But general trends—things like the pervasive social influence of the internet, the development or nondevelopment of space resources or genetic engineering, the effects of new media on politics and how people relate to their nominal leaders and other celebrities—these things will have profound effects on what sort of future we get, and decisions about them have to be made right now. So it is very much the concern of science fiction—and the kinds of

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people who read and write it—to consider what recent changes in technology and society have done to us, where they might be taking us, and whether that's really where we want to go.

Thus we will continue to explore such things in both fiction and nonfiction, and encourage each approach to lead the other into new territory. Certainly science fiction itself is *one* worthwhile subject for thought and discussion, but it is far from the only one, or even the most important one, of interest to science fiction readers. Science fiction itself is valuable mainly as a means to certain ends, which might be summed up neatly, if perhaps oversimply, as entertainment, enlightenment, and exploration. Certainly those of us who work in it have, and should have, a strong interest in using its techniques and arts as skillfully and effectively as possible. To that end we often talk among ourselves about how it might best be done, how others have done it, and what significance it all has. I've written quite a bit about science fiction myself, in articles and books elsewhere, and occasionally even in editorials here.

But I don't think *Analog* is the best place to do very much of it. Readers whose main interest is literary how-to or criticism can look elsewhere, in places specifically dedicated to those matters. Doing too much of it here would smack of omphaloskepsis. Science fiction is certainly important to the people who read or write it, but the things science fiction is *about* are more important to all of us. So we are well advised to devote more of our attention to those than to the science-fiction-ness of science fiction.

When I was in high school, there was a time when I wanted to become an amateur radio operator, partly because I found electronics intriguing but at least as much because I imagined it as a means of conversing with people all over the world about all kinds of things. My interest in it dwindled somewhat when I listened to a lot of ham radio and found that radio amateurs on the air seemed to talk mostly about amateur radio. The medium had become the message—almost the only message that seemed to get much air time.

I saw radio as a tool for dealing with subject matter beyond itself, and so do I see science fiction. Certainly I'm interested in the tool, but I would not want *Analog* to become a medium that is more interested in itself and how it ponders the Universe than in the Universe itself. ■

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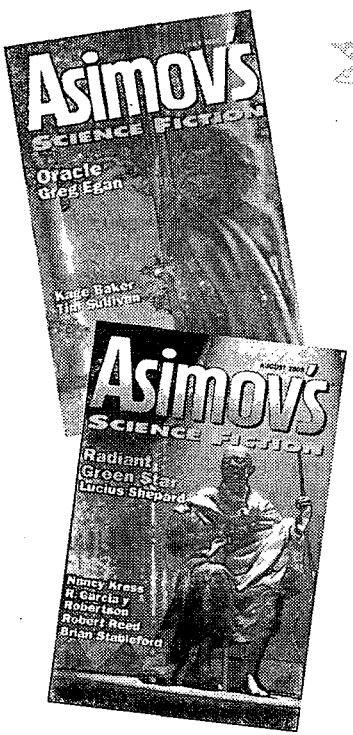

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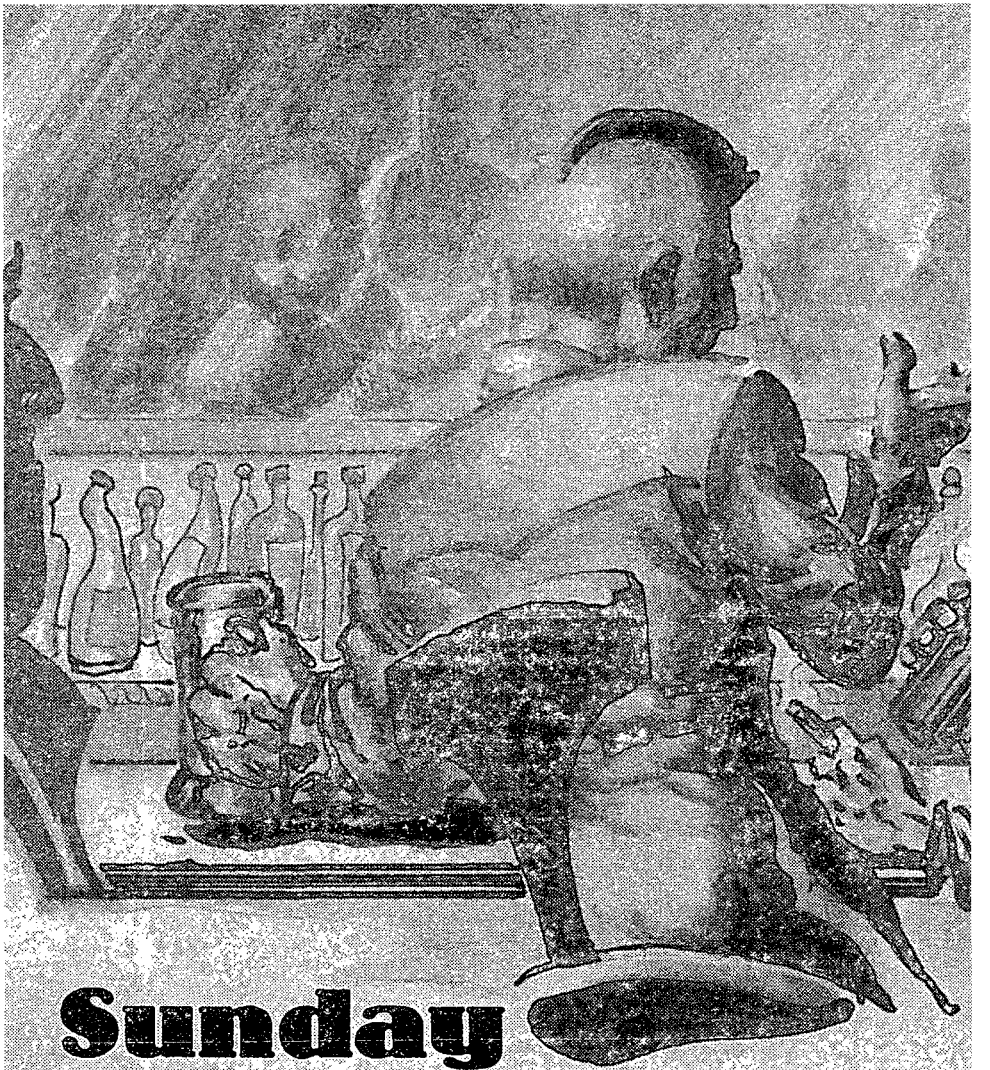

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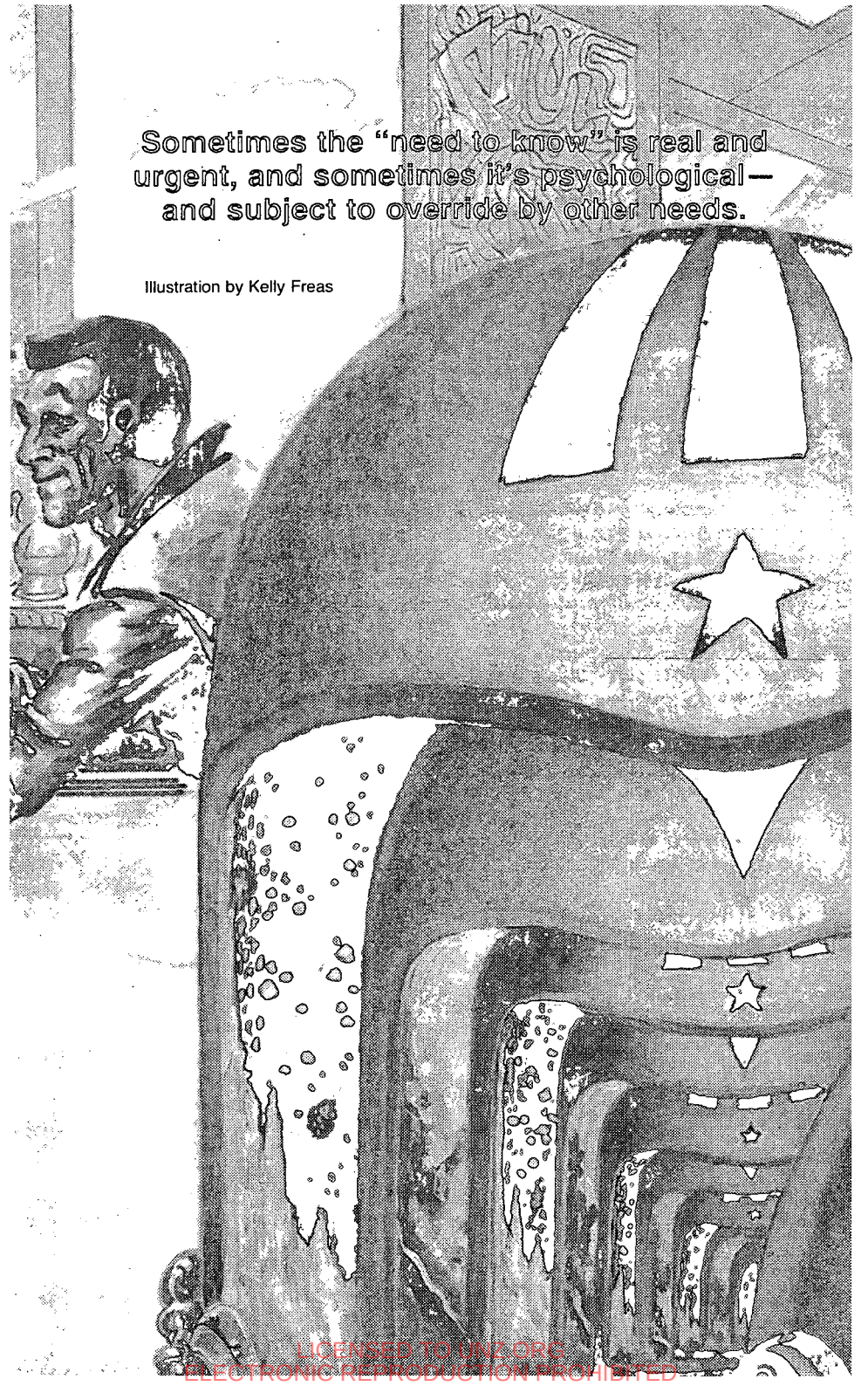

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Frontiers never die. They just become theme parks.

I spent most of my shuttle ride to Nearside mulling sour thoughts about that. It's the kind of thing that only bothers lonely and nostalgic old men, especially when we're old enough to remember the days when a trip to Luna was not a routine commuter run, but instead a never-ending series of course corrections, systems checks, best-and-worst case simulations, and random unexpected crises ranging from ominous burning smells to the surreal balls of floating upchuck that got into everywhere if we didn't get over our nausea fast enough to clean them up. Folks of my vintage remember what it was to spend half their lives in passionate competition with dozens of other frighteningly qualified people, just to earn themselves seats on cramped rigs outfitted by the lowest corporate bidders—and then to look down at the ragged landscape of Sister Moon and know that the sight itself was a privilege well worth the effort. But that's old news now: before the first development crews gave way to the first settlements; before the first settlements became large enough to be called the first cities; before the first city held a parade in honor of its first confirmed mugging; before Independence and the Corporate Communities and the opening of Lunar Disney on the Sea of Tranquility. These days, the Moon itself is no big deal except for rubes and old-timers. Nobody looks out the windows; they're far too interested in their sims, or their virts, or their newspads or (for a vanishingly literate few) their paperback novels, to care about the sight of the airless world waxing large in the darkness outside.

I wanted to shout at them. I wanted to make a great big eloquent speech about what they were missing by taking it all for granted, and about their total failure to appreciate what others had gone through to pave the way. But that wouldn't have moved anybody. It just would have established me as just another boring old fart.

So I stayed quiet until we landed, and then I rolled my overnighter down the aisle, and I made my way through the vast carpeted terminal at Armstrong Interplanetary (thinking all the while carpet, carpet, why is there carpet, dammit, there shouldn't be carpeting on the Moon). Then I hopped a tram to my hotel, and I confirmed that the front desk had followed instructions and provided me one of their few (hideously expensive) rooms with an outside view. Then I went upstairs and thought it all again when I saw that the view was just an alien distortion of the Moon I had known. Though it was night, and the landscape was as dark as the constellations of manmade illumination peppered across its cratered surface would now ever allow it to be, I still saw marquee-sized advertisements for soy houses, strip clubs, rotating restaurants, golden arches, miniature golf courses, and the one-sixth-g Biggest Rollercoaster In the Solar System. The Earth, with Europe and Africa centered, hung silently above the blight.

I tried to imagine two gentle old people, and a golden retriever dog, wandering around somewhere in the garish paradise framed by that window.

I failed.

I wondered whether it felt good or bad to be here. I wasn't tired, which I supposed I could attribute to the sensation of renewed strength and vigor that older people are supposed to feel after making the transition to lower gravities. Certainly, my knees, which had been bothering me for more than a decade now, weren't giving me a single twinge here. But I was also here alone, a decade after burying my dear wife—and though I'd travelled around a little, in the last few years, I had never really grown used to the way the silence of a strange room, experienced alone, tastes like the death that waits for me too.

After about half an hour of feeling sor-

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ry for myself, I dressed in one of my best blue suits—an old one Claire had picked out in better days, with a cut now two styles out of date—and went to the lobby to see the concierge. I found him in the center of a lobby occupied not by adventurers or pioneers but by businessmen and tourists. He was a sallow-faced young man seated behind a flat slab of a desk, constructed from some material made to resemble polished black marble. It might have been intended to represent a Kubrick monolith lying on its side, a touch that would have been appropriate enough for the Moon but might have given the decorator too much credit for classical allusions. I found more Kubrick material in the man himself, in that he was a typical hotel functionary: courteous, professional, friendly, and as cold as a plain white wall. Beaming, he said: "Can I help you, sir?"

"I'm looking for Minnie and Earl," I told him.

His smile was an unfaltering, professional thing, that might have been scissored out of a magazine ad and Scotch-taped to the bottom half of his face. "Do you have their full names, sir?"

"Those are their full names." I confess I smiled with reminiscence. "They're both one of a kind."

"I see. And they're registered at the hotel?"

"I doubt it," I said. "They're lunar residents. I just don't have their address."

"Did you try the directory?"

"I tried that before I left Earth," I said. "They're not listed. Didn't expect them to be, either."

He hesitated a fraction of a second before continuing: "I'm not sure I know what to suggest, then—"

"I'm sure you don't," I said, unwillingly raising my voice just enough to give him a little taste of the anger and frustration and dire need that had fueled this entire trip. Being a true professional, used to dealing with obnoxious and arrogant tourists, the concierge didn't react at all: just politely waited for me to get on with it. I, on the other hand, winced before continuing: "They're before your time. Probably way before your time. But there have to be people around—old people, mostly—who know who I'm talking about. Maybe you can ask around for me? Just a little? And pass around the word that I need to talk?"

The professional smile did not change a whit, but it still acquired a distinctively dubious flavor. "Minnie and Earl, sir?"

"Minnie and Earl." I then showed him the size of the tip he'd earn if he accomplished it—big enough to make certain that he'd take the request seriously, but not so large that he'd be tempted to concoct false leads. It impressed him exactly as much as I needed it to. Too bad there was almost no chance of it accomplishing anything; I'd been making inquiries about the old folks for years. But the chances of me giving up were even smaller: not when I now knew I only had a few months left before the heart stopped beating in my chest.

They were Minnie and Earl, dammit.

And anybody who wasn't there in the early days couldn't possibly understand how much that meant.

It's a funny thing about frontiers: they're not as enchanting as the folks who work them like you to believe. And there was a lot that they didn't tell the early recruits about the joys of working on the Moon.

They didn't tell you that the air systems gave off a nasal hum that kept you from sleeping soundly at any point during your first six weeks on rotation; that the vents were considerately located directly above the bunks to eliminate any way of shutting it out; that just when you found yourself actually needing that hum to sleep something in the circulators decided to change the pitch, rendering it just a tad higher or lower so that instead of lying in bed begging that hum to shut up shut up SHUT UP you

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sat there instead wondering if the new version denoted a serious mechanical difficulty capable of asphyxiating you in your sleep.

They didn't tell you that the recycled air was a paradise for bacteria, which kept any cold or flu or ear infection constantly circulating between you and your coworkers; that the disinfectants regularly released into the atmosphere smelled bad but otherwise did nothing; that when you started sneezing and coughing it was a sure bet that everybody around you would soon be sneezing and coughing; and that it was not just colds but stomach viruses, contagious rashes and even more unpleasant things that got shared as generously as a bottle of a wine at one of the parties you had time to go to back on Earth when you were able to work only sixty or seventy hours a week. They didn't tell you that work took so very much of your time that the pleasures and concerns of normal life were no longer valid experiential input; that without that input you eventually ran out of non-work-related subjects to talk about, and found your personality withering away like an atrophied limb.

They didn't tell you about the whimsical random shortages in the bimonthly supply drops and the ensuing shortages of staples like toothpaste and toilet paper. They didn't tell you about the days when all the systems seemed to conk out at once and your deadening routine suddenly became hours of all-out frantic terror. They didn't tell you that after a while you forgot you were on the Moon and stopped sneaking looks at the battered blue marble that hung up there two weeks out of every four. They didn't tell you that after a while it stopped being a dream and became instead just a dirty and backbreaking job; one that drained you of your enthusiasm faster than you could possibly guess, and one that replaced your ambitions of building a new future with more mundane longings, like feeling once again what it was like to stand unencumbered beneath a midday sun, breathing air that tasted like air and not canned sweat.

They waited until you were done learning all of this on your own before they told you about Minnie and Earl.

I learned on a Sunday—not that I had any reason to keep track of the day; the early development teams were way too short-staffed to enjoy luxuries like days off. There were instead days when you got the shitty jobs and the days when you got the jobs slightly less shitty than the others. On that particular Sunday I had repair duty, the worst job on the Moon but for another twenty or thirty possible candidates. It involved, among them, inspecting, cleaning, and replacing the panels on the solar collectors. There were a lot of panels, since the early collector fields were five kilometers on a side, and each panel was only half a meter square. They tended to collect meteor dust (at best) and get scarred and pitted from micrometeor impacts (at worst). We'd just lost a number of them from heavier rock precipitation, which meant that in addition to replacing those, I had to examine even those that remained intact. Since the panels swiveled to follow the Sun across the sky, even a small amount of dust debris threatened to fall through the joints into the machinery below. There was never a lot of dust—sometimes it was not even visible. But it had to be removed one panel at a time.

To overhaul the assembly, you spent the whole day on your belly, crawling along the catwalks between them, removing each panel in turn, inspecting them beneath a canopy with nothing but suit light, magnifiers, and a microthin air jet. (A vacuum, of course, would have been redundant.) You replaced the panels pitted beyond repair, brought the ruined ones back to the sled for disposal, and then started all over again.

The romance of space travel? Try nine hours of hideously tedious stoop labor in a moonsuit. Try hating every minute

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of it. Try hating where you are and what you're doing and how hard you worked to qualify for this privilege. Try also hating yourself just for feeling that way—but not having any idea how to turn those feelings off.

I was muttering to myself, conjugating some of the more colorful expressions for excrement, when Phil Jacoby called. He was one of the more annoying people on the Moon: a perpetual smiler who always looked on the bright side of things and refused to react to even the most acidic sarcasm. Appropriately enough, his carrot hair and freckled cheeks always made him look like a ventriloquist's dummy. He might have been our morale officer, if we'd possessed enough bad taste to have somebody with that job title; but that would have made him even more the kind of guy you grow to hate when you really want to be in a bad mood. I dearly appreciated how distant his voice sounded, as he called my name over the radio: "Max! You bored yet, Max?"

"Sorry," I said tiredly. "Max went home."

"Home as in his quarters? Or home as in Earth?"

"There is no home here," I said. "Of course Home as on Earth."

"No return shuttles today," Phil noted. "Or any time this month. How would he manage that trick?"

"He was so fed up he decided to walk."

"Hope he took a picnic lunch or four. That's got to be a major hike."

In another mood, I might have smiled. "What's the bad news, Phil?"

"Why? You expecting bad news?"

There was a hidden glee to his tone that sounded excessive even from Jacoby. "Surprise me."

"You're quitting early. The barge will be by to pick you up in five minutes."

According to the digital readout inside my helmet, it was only 13:38 LT. The news that I wouldn't have to devote another three hours to painstaking cleanup should have cheered me considerably; instead, it rendered me about twenty times more suspicious. I said, "Phil, it will take me at least three times that long just to secure—"

"A relief shift will arrive on another barge within the hour. Don't do another minute of work. Just go back to the sled and wait for pickup. That's an order."

Which was especially strange because Jacoby was not technically my superior. Sure, he'd been on the Moon all of one hundred and twenty days longer than me—and sure, that meant any advice he had to give me needed to be treated like an order, if I wanted to do my job—but even so, he was not the kind of guy who ever ended anything with an authoritarian That's An Order. My first reaction was the certainty that I must have been in some kind of serious trouble. Somewhere, sometime, I forgot or neglected one of the safety protocols, and did something suicidally, crazily wrong—the kind of thing that once discovered would lead to me being relieved for incompetence. But I was still new on the Moon, and I couldn't think of any recent occasion where I'd been given enough responsibility for that to be a factor. My next words were especially cautious: "Uh, Phil, did I—"

"Go to the sled," he repeated, even more sternly this time. "And, Max?"

"What?" I asked.

The ebullient side of his personality returned. "I envy you, man."

The connection clicked off before I could ask him why.

A lunar barge was a lot like its terrestrial equivalent, in that it had no motive power of its very own, but needed to be pulled by another vehicle. Ours were pulled by tractors. They had no atmospheric enclosures, since ninety percent of the time they were just used for the slow-motion hauling of construction equipment; whenever they were needed to move personnel, we bolted in a number of forward-facing seats with

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oxygen feeds and canvas straps to prevent folks imprisoned by clumsy moonsuits from being knocked out of their chairs every time the flatbed dipped in the terrain. It was an extremely low-tech method of travel, not much faster than a human being could sprint, and we didn't often use it for long distances.

There were four other passengers on this one, all identical behind mirrored facemasks; I had to read their nametags to see who they were. Nikki Hollander, Oscar Desalvo, George Peterson, and Carrie Aldrin No Relation (the last two words a nigh-permanent part of her name, up here). All four of them had been on-site at least a year more than I had, and to my eyes had always seemed to be dealing with the routine a lot better than I had been. As I strapped in, and the tractor started up, and the barge began its glacial progress toward a set of lumpy peaks on the horizon, I wished my coworkers had something other than distorted reflections of the lunar landscape for faces; it would be nice to be able to judge from their expressions just what was going on here. I said: "So what's the story, people? Where we headed?"

Then Carrie Aldrin No Relation began to sing: "Over the river and through the woods, to grandmother's house we go . . ."

George Peterson snorted. Oscar Desalvo, a man not known for his giddy sense of humor, who was in fact even grimmer than me most of the time—(not from disenchantment with his work, but out of personal inclination)—giggled; it was like watching one of the figures on Mount Rushmore stick its tongue out. Nikki Hollander joined in, her considerably less-than-perfect pitch turning the rest of the song into a nails-on-blackboard cacophony. The helmet speakers, which distorted anyway, did not help.

I said, "Excuse me?"

Nikki Hollander said something so blatantly ridiculous that I couldn't force myself to believe I'd heard her correctly.

"Come again? I lost that."

"No you didn't." Her voice seemed strained, almost hysterical.

One of the men was choking with poorly repressed laughter. I couldn't tell who.

"You want to know if I like yams?"

Nikki's response was a burlesque parody of astronautic stoicism. "That's an affirmative, Houston."

"Yams, the vegetable yams?"

"*A*-ffirmative." The A emphasized and italicized so broadly that it was not so much a separate syllable as a sovereign country.

This time I recognized the strangulated noises. They were coming from George Peterson, and they were the sounds made by a man who was trying very hard not to laugh. It was several seconds before I could summon enough dignity to answer. "Yeah, I like yams. How is that relevant?"

"Classified," she said, and then her signal cut off.

In fact, all their signals cut off, though I could tell from the red indicators on my internal display that they were all still broadcasting.

That was not unusual. Coded frequencies were one of the few genuine amenities allowed us; they allowed those of us who absolutely needed a few seconds to discuss personal matters with coworkers to do so without sharing their affairs with anybody else who might be listening. We're not supposed to spend more than a couple of minutes at a time on those channels because it's safer to stay monitored. Being shut out of four signals simultaneously—in a manner that could only mean raucous laughter at my expense—was unprecedented, and it pissed me off. Hell, I'll freely admit that it did more than that; it frightened me. I was on the verge of suspecting brain damage caused by something wrong with the air supply.

Then George Peterson's voice clicked: "Sorry about that, old buddy." (I'd never

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been his old buddy.) "We usually do a better job keeping a straight face."

"At what? Mind telling me what's going on here?"

"One minute." He performed the series of maneuvers necessary to cut off the oxygen provided by the barge, and restore his dependence on the supply contained in his suit, then unstrapped his harnesses, stood, and moved toward me, swaying slightly from the bumps and jars of our imperfectly smooth ride across the lunar surface.

It was, of course, against all safety regulations for him to be on his feet while the barge was in motion; after all, even as glacially slow as that was, it wouldn't have taken all that great an imperfection in the road before us to knock him down and perhaps inflict the kind of hairline puncture capable of leaving him with a slight case of death. We had all disobeyed that particular rule from time to time; there were just too many practical advantages in being able to move around at will, without first ordering the tractor to stop. But it made no sense for him to come over now, just to talk, as if it really made a difference for us to be face-to-face. After all, we weren't faces. We were a pair of convex mirrors, reflecting each other while the men behind them spoke on radios too powerful to be noticeably improved by a few less meters of distance.

Even so, he sat down on a steel crate lashed to the deck before me, and positioned his faceplate opposite mine, his body language suggesting meaningful eye contact. He held that position for almost a minute, not saying anything, not moving, behaving exactly like a man who believed he was staring me down.

It made no sense. I could have gone to sleep and he wouldn't have noticed.

Instead, I said: "What?"

He spoke quietly: "Am I correct in observing that you've felt less than, shall we say . . . 'inspired', by your responsibilities here?"

Oh, Christ. This was about something I'd done.

"Is there some kind of problem?"

George's helmet trembled enough to a suggested a man theatrically shaking his head inside it. "Lighten up, Max. Nobody has any complaints about your work. We think you're one of the best people we have here, and your next evaluation is going to give you straight A's in every department . . . except enthusiasm. You just don't seem to believe in the work anymore."

As much as I tried to avoid it, my answer still reeked with denial. "I believe in it."

"You believe in the idea of it," George said. "But the reality has worn you down."

I was stiff, proper, absolutely correct, and absolutely transparent. "I was trained. I spent a full year in simulation, doing all the same jobs. I knew what it was going to be like. I knew what to expect."

"No amount of training can prepare you for the moment when you think you can't feel the magic anymore."

"And you can?" I asked, unable to keep the scorn from my voice.

The speakers inside lunar helmets were still pretty tinny in those days; they no longer transformed everything we said into the monotones that once upon a time helped get an entire country fed up with the forced badinage of Apollo, but neither were they much good at conveying the most precise of emotional cues. And yet I was able to pick up something in George's tone that was, given my mood, capable of profoundly disturbing me: a strange, transcendent joy. "Oh, yes. Max. I can."

I was just unnerved enough to ask: "How?"

"I'm swimming in it," he said—and even as long as he'd been part of the secret, his voice still quavered, as if there was some seven-year-old part of him that remained unwilling to believe that it could possibly be. "We're all swimming in it."

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"I'm not."

And he laughed out loud. "Don't worry. We're going to gang up and shove you into the deep end of the pool."

That was seventy years ago.

Seventy years. I think about how old that makes me and I cringe. Seventy years ago, the vast majority of old farts who somehow managed to make it to the age I am now were almost always living on the outer edges of decrepitude. The physical problems were nothing compared with the senility. What's that? You don't remember senile dementia? Really? I guess there's a joke in there somewhere, but it's not that funny for those of us who can remember actually considering it a possible future. Trust me, it was a nightmare. And the day they licked that one was one hell of an advertisement for progress.

But still, seventy years. You want to know how long ago that was? Seventy years ago it was still possible to find people who had heard of Bruce Springsteen. There were even some who remembered the Beatles. Stephen King was still coming out with his last few books, Kate Emma Brenner hadn't yet come out with any, Exxon was still in business, the reconstruction of the ice packs hadn't even been proposed, India and Pakistan hadn't reconciled, and the idea of astronauts going out into space to blow up a giant asteroid before it impacted with Earth was not an anecdote from recent history but a half-remembered image from a movie your father talked about going to see when he was a kid. Seventy years ago the most pressing headlines had to do with the worldwide ecological threat posed by the population explosion among escaped sugar gliders.

Seventy years ago, I hadn't met Claire. She was still married to her first husband, the one she described as the nice mistake. She had no idea I was anywhere in her future. I had no idea she was anywhere in mine. The void hadn't been defined yet, let alone filled. (Nor had it been cruelly emptied again—and wasn't it sad how the void I'd lived with for so long seemed a lot larger, once I needed to endure it again?)

Seventy years ago I thought Faisal Awad was an old man. He may have been in his mid-thirties then, at most ten years older than I was. That, to me, was old. These days it seems one step removed from the crib.

I haven't mentioned Faisal yet; he wasn't along the day George and the others picked me up in the barge, and we didn't become friends til later. But he was a major member of the development team, back then—the kind of fixitall adventurer who could use the coffee machine in the common room to repair the heating system in the clinic. If you don't think that's a valuable skill, try living under 24-7 life support in a hostile environment where any requisitions for spare parts had to be debated and voted upon by a government committee during election years. It's the time of my life when I first developed my deep abiding hatred of Senators. Faisal was our lifesaver, our miracle worker, and our biggest local authority on the works of Gilbert and Sullivan, though back then we were all too busy to listen to music and much more likely to listen to that 15-minute wonder Polka Thug anyway. After I left the Moon, and the decades of my life fluttered by faster than I once could have imagined possible, I used to think about Faisal and decide that I really ought to look him up, someday, maybe, as soon as I had the chance. But he had stayed on Luna, and I had gone back to Earth, and what with one thing or another that resolution had worked out as well as such oughtas always do: a lesson that old men have learned too late for as long as there have been old men to learn it.

I didn't even know how long he'd been dead until I heard it from his granddaughter Janine Seuss, a third-generation lunar I was able to track down with the

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help of the Selene Historical Society. She was a slightly-built thirty-seven-year-old with stylishly mismatched eye color and hair micro-styled into infinitesimal pixels that, when combed correctly, formed the famous old black-and-white news photograph of that doomed young girl giving the finger to the cops at the San Diego riots of some thirty years ago. Though she had graciously agreed to meet me, she hadn't had time to arrange her hair properly, and the photo was eerily distorted, like an image captured and then distorted on putty. She served coffee, which I can't drink anymore but which I accepted anyway, then sat down on her couch with the frantically miaowing Siamese.

"There were still blowouts then," she said. "Some genuine accidents, some bombings arranged by the Flat-Mooners. It was one of the Flat-Mooners who got Poppy. He was taking Mermer—our name for Grandma—to the movies up on topside; back then, they used to project them on this big white screen a couple of kilometers outside, though it was always some damn thing fifty or a hundred years old with dialogue that didn't make sense and stories you had to be older than Moses to appreciate. Anyway, the commuter tram they were riding just went boom and opened up into pure vacuum. Poppy and Mermer and about fourteen others got sucked out." She took a deep breath, then let it out all at once. "That was almost twenty years ago."

What else can you say, when you hear a story like that? "I'm sorry."

She acknowledged that with an equally ritual response. "Thanks."

"Did they catch the people responsible?"

"Right away. They were a bunch of losers. Unemployed illiterate idiots."

I remembered the days when the only idiots on the Moon were highly-educated and overworked ones. After a moment, I said: "Did he ever talk about the early days? The development teams?"

She smiled. "Ever? It was practically all he ever did talk about. You kids don't bleh bleh bleh. He used to get mad at the vids that made it look like a time of sheriffs and saloons and gunfights—he guessed they probably made good stories for kids who didn't know any better, but kept complaining that life back then wasn't anything like that. He said there was always too much work to do to strap on six-guns and go gunning for each other."

"He was right," I said. (There was a grand total of one gunfight in the first thirty years of lunar settlement—and it's not part of this story.)

"Most of his stories about those days had to do with things breaking down and him being the only person who could fix them in the nick of time. He told reconditioned-software anecdotes. Finding-the-rotten-air-filter anecdotes. Improvise-joint-lubricant anecdotes. Lots of them."

"That was Faisal."

She petted the cat. (It was a heavy-lidded, meatloaf-shaped thing that probably bestirred itself only at the sound of a can opener: we'd tamed the Moon so utterly that people like Janine were able to spare some pampering for their pets.) "Bleh. I prefer the gunfights."

I leaned forward and asked the important question. "Did he ever mention anybody named Minnie and Earl?"

"Were those a couple of folks from way back then?"

"You could say that."

"No last names?"

"None they ever used."

She thought about that, and said: "Would they have been folks he knew only slightly? Or important people?"

"Very important people," I said. "It's vital that I reach them."

She frowned. "It was a long time ago. Can you be sure they're still alive?"

"Absolutely," I said.

She considered that for a second. "No, I'm sorry. But you have to realize it was a long time ago for me too. I don't

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remember him mentioning anybody."

Faisal was the last of the people I'd known from my days on the Moon. There were a couple on Earth, but both had flatly denied any knowledge of Minnie and Earl. Casting about for last straws, I said: "Do you have anything that belonged to him?"

"No, I don't. But I know where you can go to look further."

Seventy years ago, after being picked up by the barge:

Nobody spoke to me again for forty-five minutes, which only fueled my suspicions of mass insanity.

The barge itself made slow but steady progress, following a generally uphill course of the only kind possible in that era, in that place, on the Moon: which was to say, serpentine. The landscape here was rough, pocked with craters and jagged outcroppings, in no place willing to respect how convenient it might have been to allow us to proceed in something approaching a straight line. There were places where we had to turn almost a hundred and eighty degrees, double back a while, then turn again, to head in an entirely different direction; it was the kind of route that looks random from one minute to the next but gradually reveals progress in one direction or another. It was clearly a route that my colleagues had travelled many times before; nobody seemed impatient. But for the one guy who had absolutely no idea where we were going, and who wasn't in fact certain that we were headed anywhere at all, it was torture.

We would have managed the trip in maybe one-tenth the time in one of our fliers, but I later learned that the very laboriousness of the journey was, for first-timers at least, a traditional part of the show. It gave us time to speculate, to anticipate. This was useful for unlimbering the mind, ironing the kinks out of the imagination, getting us used to the idea that we were headed someplace important enough to be worth the trip. The buildup couldn't possibly be enough—the view over that last ridge was still going to hit us with the force of a sledgehammer to the brain—but I remember how hard it hit and I'm still thankful the shock was cushioned even as inadequately as it was.

We followed a long boring ridge for the better part of fifteen minutes . . . then began to climb a slope that bore the rutty look of lunar ground that had known tractor-treads hundreds of times before. Some of my fellow journeyers hummed ominous, horror-movie soundtrack music in my ear, but George's voice overrode them all: "Max? Did Phil tell you he envied you this moment?"

I was really nervous now. "Yes."

"He's full of crap. You're not going to enjoy this next bit except in retrospect. Later on you'll think of it as the best moment of your life—and it might even be—but it won't feel like that when it happens. It'll feel big and frightening and insane when it happens. Trust me now when I tell you that it will get better, and quickly . . . and that everything will be explained, if not completely, then at least as much as it needs to be."

It was an odd turn of phrase. "As much as it needs to be? What's that supposed to—"

That's when the barge reached the top of the rise, providing us a nice panoramic view of what awaited us in the shallow depression on the other side.

My ability to form coherent sentences became a distant rumor.

It was the kind of moment when the entire Universe seems to become a wobbly thing, propped up by scaffolding and held together with the cheapest brand of hardware-store nails. The kind of moment when gravity just turns sideways beneath you, and the whole world turns on its edge, and the only thing that prevents you from just jetting off into space to spontaneously combust is the compensatory total stoppage of time. I

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don't know the first thing I said. I'm glad nobody ever played me the recordings that got filed away in the permanent mission archives . . . and I'm equally sure that the reason they didn't is that anybody actually on the Moon to listen to them must have also had their own equally aghast reactions saved for posterity. I got to hear such sounds many times, from others I would later escort over that ridge myself— and I can absolutely assure you that it's the sound made by intelligent, educated people who first think they've gone insane, and who then realize it doesn't help to know that they haven't.

It was the only possible immediate reaction to the first sight of Minnie and Earl's.

What I saw, as we crested the top of that ridge, was this:

In the center of a typically barren lunar landscape, surrounded on all sides by impact craters, rocks, more rocks, and the suffocating emptiness of vacuum—

—a dark landscape, mind you, one imprisoned by lunar night, and illuminated only by the gibbous Earth hanging high above us—

—a rectangle of color and light, in the form of four acres of freshly-watered, freshly mowed lawn.

With a house on it.

Not a prefab box of the kind we dropped all over the lunar landscape for storage and emergency air stops.

A house.

A clapboard family home, painted a homey yellow, with a wraparound porch three steps off the ground, a canopy to keep off the Sun, a screen door leading inside and a bug-zapper over the threshold. There was a porch swing with cushions in a big yellow daisy pattern, and a wall of neatly-trimmed hedges around the house, obscuring the latticework that enclosed the crawlspace underneath. It was so over-the-top middle American that even in that first moment, I half-crazily expected the scent of lemonade to cross the vacuum and enter my suit. (That didn't happen, but lemonade was waiting.) The lawn was completely surrounded with a white picket fence with an open gate; there was even an old-fashioned mailbox at the gate, with its flag up. All of it was lit, from nowhere, like a bright summer afternoon. The house itself had two stories, plus a sloping shingled roof high enough to hide a respectable attic; as we drew closer I saw that there were pull-down shades, not venetian blinds, in the pane-glass windows. Closer still, and I spotted the golden retriever that lay on the porch, its head resting between muddy paws as it followed our approach; it was definitely a lazy dog, since it did not get up to investigate us, but it was also a friendly one, whose big red tail thumped against the porch in greeting. Closer still, and I made various consonant noises as a venerable old lady in gardening overalls came around the side of the house, spotted us, and broke into the kind of smile native only to contented old ladies seeing good friends or grandchildren after too long away. When my fellow astronauts all waved back, I almost followed their lead, but for some reason my arms wouldn't move.

Somewhere in there I murmured, "This is impossible."

"Clearly not," George said. "If it were impossible it wouldn't be happening. The more accurate word is inexplicable."

"What the hell is—"

"Come on, goofball." This from Carrie Aldrin No Relation. "You're acting like you never saw a house before."

Sometimes, knowing when to keep your mouth shut is the most eloquent expression of wisdom. I shut up.

It took about a million and a half years—or five minutes if you go by merely chronological time—for the tractor to descend the shallow slope and bring us to a stop some twenty meters from the front gate. By then an old man

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had joined the old woman at the fence. He was a lean old codger with bright blue eyes, a nose like a hawk, a smile that suggested he'd just heard a whopper of a joke, and the kind of forehead some very old men have—the kind that by all rights ought to have been glistening with sweat, like most bald heads, but instead seemed perpetually dry, in a way that suggested a sophisticated system for the redistribution of excess moisture. He had the leathery look of old men who had spent much of their lives working in the Sun. He wore neatly-pressed tan pants, sandals, and a white button-down shirt open at the collar, all of which was slightly loose on him—not enough to make him look comical or pathetic, but enough to suggest that he'd been a somewhat bigger man before age had diminished him, and was still used to buying the larger sizes. (That is, I thought, if there was any possibility of him finding a good place to shop around here.)

His wife, if that's who she was, was half a head shorter and slightly stouter; she had blue eyes and a bright smile, like him, but a soft and rounded face that provided a pleasant complement to his lean and angular one. She was just overweight enough to provide her with the homey accoutrements of chubby cheeks and double chin; unlike her weathered, bone-dry husband, she was smooth-skinned and shiny-faced and very much a creature the Sun had left untouched (though she evidently spent time there; at least, she wore gardener's gloves, and carried a spade).

They were, in short, vaguely reminiscent of the old folks standing before the farmhouse in that famous old painting "American Gothic". You know the one I mean—the constipated old guy with the pitchfork next to the wife who seems mortified by his very presence? These two were those two after they cheered up enough to be worth meeting.

Except, of course, that this couldn't possibly be happening.

My colleagues unstrapped themselves, lowered the stairway, and disembarked. The tractor driver, whoever he was, emerged from its cab and joined them. George stayed with me, watching my every move, as I proved capable of climbing down a set of three steps without demonstrating my total incapacitation from shock. When my boots crunched lunar gravel—a texture I could feel right through the treads of my boots, and which served at that moment to reconnect me to ordinary physical reality—Carrie, Oscar, and Nikki patted me on the back, a gesture that felt like half-congratulation and, half-commiseration. The driver came by, too; I saw from the markings on his suit that he was Pete Rawlik, who was assigned to some kind of classified biochemical research in one of our outlabs; he had always been too busy to mix much, and I'd met him maybe twice by that point, but he still clapped my shoulder like an old friend. As for George, he made a wait gesture and went back up the steps.

In the thirty seconds we stood there waiting for him, I looked up at the picket fence, just to confirm that the impossible old couple was still there, and I saw that the golden retriever, which had joined its masters at the gate, was barking silently. That was good. If the sound had carried in vacuum, I might have been worried. That would have been just plain crazy.

Then George came back, carrying an airtight metal cylinder just about big enough to hold a soccer ball. I hadn't seen any vacuum boxes of that particular shape and size before, but any confusion I might have felt about that was just about the last thing I needed to worry about. He addressed the others: "How's he doing?"

A babble of noncommittal OKs dueled for broadcast supremacy. Then the voices resolved into individuals.

Nikki Hollander said: "Well, at least he's not babbling anymore."

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Oscar Desalvo snorted: "I attribute that to brain-lock."

"You weren't any better," said Carrie Aldrin No Relation. "Worse. If I recall correctly, you made a mess in your suit."

"I'm not claiming any position of false superiority, hon. Just giving my considered diagnosis."

"Whatever," said Pete Rawlik. "Let's just cross the fenceline, already. I have an itch."

"In a second," George said. His mirrored faceplate turned toward mine, aping eye-contact. "Max? You getting this?"

"Barely," I managed.

"Outstanding. You're doing fine. But I need you with me a hundred percent while I cover our most important ground rule. Namely—everything inside that picket fence is a temperature-climate, sea-level, terrestrial environment. You don't have to worry about air filtration, temperature levels, or anything else. It's totally safe to suit down, as long as you're inside the perimeter—and in a few minutes, we will all be doing just that. But once you're inside that enclosure, the picket fence itself marks the beginning of lunar vacuum, lunar temperatures, and everything that implies. You do not, repeat not, do anything to test the differential. Even sticking a finger out between the slats is enough to get you bounced from the program, with no possibility of reprieve. Is that clear?"

"Yes, but—"

"Rule Two," he said, handing me the sealed metal box. "You're the new guy. You carry the pie."

I regarded the cylinder. Pie?

I kept waiting for the other shoe to drop, but it never did.

The instant we passed through the front gate, the dead world this should have been surrendered to a living one. Sound returned between one step and the next. The welcoming cries of the two old people—and the barking of their friendly golden retriever dog—may have been muffled by my helmet, but they were still identifiable enough to present touches of personality. The old man's voice was gruff in a manner that implied a past flavored by whiskey and cigars, but there was also a sing-song quality to it, that instantly manifested itself as a tendency to end his sentences at higher registers. The old woman's voice was soft and breathy, with only the vaguest suggestion of an old-age quaver and a compensatory tinge of the purest Georgia Peach. The dog's barks were like little frenzied explosions, that might have been threatening if they hadn't all trailed off into quizzical whines. It was a symphony of various sounds that could be made for hello: laughs, cries, yips, and delighted shouts of *George! Oscar! Nikki! Carrie! Pete! So glad you could make it! How are you?*

It was enough to return me to statue mode. I didn't even move when the others disengaged their helmet locks, doffed their headgear, and began oohing and aahing themselves. I just spent the next couple of minutes watching, physically in their midst but mentally somewhere very far away, as the parade of impossibilities passed on by. I noted that Carrie Aldrin No Relation, who usually wore her long red hair beneath the tightest of protective nets, was today styled in pigtails with big pink bows; that Oscar, who was habitually scraggly-haired and two days into a beard, was today perfectly kempt and freshly shaven; that George giggled like a five-year-old when the dog stood up on its hind legs to slobber all over his face; and that Pete engaged with a little mock wrestling match with the old man that almost left him toppling backward onto the grass. I saw the women whisper to each other, then bound up the porch steps into the house, so excitedly that they reminded me of schoolgirls skipping off to the playground—a gait that should have been impossible to simulate in a bulky moonsuit, but which they pulled off with perfect flair. I saw Pete and Oscar

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follow along behind them, laughing at a shared joke.

I was totally ignored until the dog stood up on its hind legs to sniff at, then snort nasal condensation on, my faceplate. His ears went back. He whined, then scratched at his reflection, then looked over his shoulder at the rest of his pack, long pink tongue lolling plaintively. *Look, guys. There's somebody in this thing.*

I didn't know I was going to take the leap of faith until I actually placed the pie cylinder on the ground, then reached up and undid my helmet locks. The hiss of escaping air made my blood freeze in my chest; for a second I was absolutely certain that all of this was a hallucination brought on by oxygen deprivation, and that I'd just committed suicide by opening my suit to vacuum. But the hiss subsided, and I realized that it was just pressure equalization; the atmosphere in this environment must have been slightly less than that provided by the suit. A second later, as I removed my helmet, I tasted golden retriever breath as the dog leaned in close and said hello by licking me on the lips. I also smelled freshly mowed grass and the perfume of nearby flowers: I heard a bird not too far away go whoot-toot-toot-weet; and I felt direct sunlight on my face, even though the Sun itself was nowhere to be seen. The air itself was pleasantly warm, like summer before it gets obnoxious with heat and humidity.

"Miles!" the old man said. "Get down!"

The dog gave me one last lick for the road and sat down, gazing up at me with that species of tongue-lolling amusement known only to large canines.

The old woman clutched the elbow of George's suit. "Oh, you didn't tell me you were bringing somebody new this time! How wonderful!"

"What is this place?" I managed.

The old man raised his eyebrows. "It's our front yard, son. What does it look like?"

The old woman slapped his hand lightly. "Be nice, dear. You can see he's taking it hard."

He grunted. "Always did beat me how you can tell what a guy's thinking and feeling just by looking at him."

She patted his arm again. "It's not all that unusual, apricot. I'm a woman."

George ambled on over, pulling the two oldsters along. "All right, I'll get it started. Max Fischer, I want you to meet two of the best people on this world or any other—Minnie and Earl. Minnie and Earl, I want you to meet a guy who's not quite as hopeless as he probably seems on first impression—Max Fischer. You'll like him."

"I like him already," Minnie said. "I've yet to dislike anybody the dog took such an immediate shine to. Hi, Max."

"Hello," I said. After a moment: "Minnie. Earl."

"Wonderful to meet you, young man. Your friends have said so much about you."

"Thanks." Shock lent honesty to my response: "They've said absolutely nothing about you."

"They never do," she said, with infinite sadness, as George smirked at me over her back. She glanced down at the metal cylinder at my feet, and cooed: "Is that cake?"

Suddenly, absurdly, the first rule of family visits popped unbidden into my head, blaring its commandment in flaming letters twenty miles high: THOU SHALT NOT PUT THE PIE YOU BROUGHT ON THE GROUND—ESPECIALLY NOT WHEN A DOG IS PRESENT. Never mind that the container was sealed against vacuum, and that the dog would have needed twenty minutes to get in with an industrial drill: the lessons of everyday American socialization still applied. I picked it up and handed it to her; she took it with her bare hands, reacting not at all to what hindsight later informed me should have been a painfully cold exterior. I said: "Sorry."

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"It's pie," said George. "Deep-dish apple pie. Direct from my grandma's orchard."

"Oh, that's sweet of her. She still having those back problems?"

"She's getting on in years," George allowed. "But she says that soup of yours really helped."

"I'm glad," she said, her smile as sunny as the entire month of July. "Meanwhile, why don't you take your friend upstairs and get him out of that horrid suit? I'm sure he'll feel a lot better once he's had a chance to freshen up. Earl can have a drink set for him by the time you come down."

"I'll fix a Sea of Tranquility," Earl said, with enthusiasm.

"Maybe once he has his feet under him. A beer should be fine for now."

"All rightee," said Earl, with the kind of wink that established he knew quite well I was going to need something a lot more substantial than beer.

As for Minnie, she seized my hand, and said: "It'll be all right, apricot. Once you get past this stage, I'm sure we're all going to be great friends."

"Um," I replied, with perfect eloquence, wondering just what stage I was being expected to pass.

Sanity?

Dying inside, I did what seemed to be appropriate. I followed George through the front door (first stamping my moonboots on the mat, as he specified) and up the narrow, creaky wooden staircase.

You ever go to parties where the guests leave their coats in a heap on the bed of the master bedroom? Minnie and Earl's was like that. Except it wasn't a pile of coats, but a pile of disassembled moonsuits. There were actually two bedrooms upstairs—the women changed in the master bedroom that evidently belonged to the oldsters themselves, the men in a smaller room that felt like it belonged to a teenage boy. The wallpaper was a pattern of galloping horses, and the bookcases were filled with mint-edition paperback thrillers that must have been a hundred years old even then. (Or more: there was a complete collection of the hardcover Hardy Boys Mysteries, by Franklin W. Dixon.) The desk was a genuine antique rolltop, with a green blotter; no computer or hytex. The bed was just big enough to hold one gangly teenager, or three moonsuits disassembled into their component parts, with a special towel provided so our boots wouldn't get moondust all over the bedspread. By the time George and I got up there, Oscar and Pete had already changed into slacks, dress shoes with black socks, and button-down shirts with red bowties; Pete had even put some shiny gunk in his hair to slick it back. They winked at me as they left.

I didn't change, not immediately; nor did I speak, not even as George doffed his own moonsuit and jumpers in favor of a similarly earthbound outfit he blithely salvaged from the closet. The conviction that I was being tested, somehow, was so overwhelming that the interior of my suit must have been a puddle of flop sweat.

Then George said: "You going to be comfortable, dressed like that all night?"

I stirred. "Clothes?"

He pulled an outfit my size from the closet—tan pants, a blue short-sleeved button-down shirt, gleaming black shoes, and a red bowtie identical to the ones Oscar and Pete had donned. "No problem borrowing. Minnie keeps an ample supply. You don't like the selection, you want to pick something more your style, you can always have something snazzier sent up on the next supply drop. I promise you, she'll appreciate the extra effort. It makes her day when—"

"George," I said softly.

"Have trouble with bowties? No problem. They're optional. You can—"

"George," I said again, and this time my voice was a little louder, a little deeper, a little more *For Christ's Sake Shut*

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Up I'm Sick Of This Shit.

He batted his eyes, all innocence and naivete. "Yes, Max?"

My look, by contrast, must have been half-murderous. "Tell me."

"Tell you what?"

It was very hard not to yell. "You know what!"

He fingered an old issue of some garishly-colored turn-of-the-millennium science fiction magazine. "Oh. That mixed drink Earl mentioned. The Sea of Tranquility. It's his own invention, and he calls it that because your first sip is one small step for Man, and your second is one giant leap for Mankind. There's peppermint in it. Give it a try and I promise you you'll be on his good side for life. He—"

I squeezed the words through clenched teeth. "I . . . don't . . . care . . . about . . . the . . . bloody . . . drink."

"Then I'm afraid I don't see your problem."

"My problem," I said, slowly, and with carefully repressed frustration, "is that all of this is downright impossible."

"Apparently not," he noted.

"I want to know who these people are, and what they're doing here."

"They're Minnie and Earl, and they're having some friends over for dinner."

If I'd been five years old, I might have pouted and stamped my foot. (Sometimes, remembering, I think I did anyway.) "Dammit, George!"

He remained supernaturally calm. "No cursing in this house, Max. Minnie doesn't like it. She won't throw you out for doing it—she's too nice for that—but it does make her uncomfortable."

This is the point where I absolutely know I stamped my foot. "That makes *her* uncomfortable!?"

He put down the skiffy magazine. "Really. I don't see why you're having such a problem with this. They're just this great old couple who happen to live in a little country house on the Moon, and their favorite thing is getting together with friends, and we're here to have Sunday night dinner with them. Easy to understand . . . especially if you accept that it's all there is."

"That can't be all there is!" I cried, my exasperation reaching critical mass.

"Why not? Can't 'Just Because' qualify as a proper scientific theory?"

"No! It doesn't!—How come you never told me about this place before?"

"You never asked before." He adjusted his tie, glanced at the outfit laid out for me on the bed, and went to the door. "Don't worry; it didn't for me, either. Something close to an explanation is forthcoming. Just get dressed and come downstairs already. We don't want the folks to think you're antisocial . . ."

I'd been exasperated, way back then, because Minnie and Earl were there and had no right to be. I was exasperated now because the more I looked, the more impossible it became to find any indication that they'd ever been there at all.

I had started looking for them, if only in a desultory, abstracted way, shortly after Claire died. She'd been the only person on Earth who had ever believed my stories about them. Even now, I think it's a small miracle that she did. I had told her the story of Minnie and Earl before we even became man and wife—sometime after I knew I was going to propose, but before I found the right time and place for the question. I was just back from a couple of years of Outer-System work, had grown weary of the life, and had met this spectacularly kind and funny and beautiful person whose interests were all on Earth, and who had no real desire to go out into space herself. That was just fine with me. It was what I wanted too. And of course I rarely talked to her about my years in space, because I didn't want to become an old bore with a suitcase full of old stories. Even so, I still knew, at the beginning, that knowing about a real-life miracle and not mentioning it to her, ever, just because she was not likely to

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believe me, was tantamount to cheating. So I sat her down one day, even before the proposal, and told her about Minnie and Earl. And she believed me. She didn't humor me. She didn't just say she believed me. She didn't just believe me to be nice. She believed me. She said she always knew when I was shoveling manure and when I was not—a boast that turned out to be an integral strength of our marriage—and that it was impossible for her to hear me tell the story without knowing that Minnie and Earl were real. She said that if we had children I would have to tell the story to them, too, to pass it on.

That was one of the special things about Claire: she had faith when faith was needed.

But our son and our daughter, and later the grandkids, outgrew believing me. For them, Minnie and Earl were whimsical space-age versions of Santa.

I didn't mind that, not really.

But when she died, finding Minnie and Earl again seemed very important.

It wasn't just that their house was gone, or that Minnie and Earl seemed to have departed for regions unknown; and it wasn't just that the official histories of the early development teams now completely omitted any mention of the secret hoarded by everybody who had ever spent time on the Moon in those days. It wasn't just that the classified files I had read and eventually contributed to had disappeared, flushed down the same hole that sends all embarrassing government secrets down the pipe to their final resting place in the sea. But for more years than I'd ever wanted to count, Minnie and Earl had been the secret history nobody ever talked about. I had spoken to those of my old colleagues who still remained alive, and they had all said, what are you talking about, what do you mean, are you feeling all right, nothing like that ever happened.

It was tempting to believe that my kids were right: that it had been a fairy tale: a little harmless personal fantasy I'd been carrying around with me for most of my life.

But I knew it wasn't.

Because Claire had believed me.

Because whenever I did drag out the old stories one more time, she always said, "I wish I'd known them." Not like an indulgent wife allowing the old man his delusions, but like a woman well acquainted with miracles. And because even if I was getting too old to always trust my own judgement, nothing would ever make me doubt hers.

I searched with phone calls, with letters, with hytex research, with the calling-in of old favors, with every tool available to me. I found nothing.

And then one day I was told that I didn't have much more time to look. It wasn't a tragedy; I'd lived a long and happy life. And it wasn't as bad as it could have been; I'd been assured that there wouldn't be much pain. But I did have that one little unresolved question still hanging over my head

That was the day I overcame decades of resistance and booked return passage to the world I had once helped to build.

The day after I spoke to Janine Seuss, I followed her advice and took a commuter tram to the Michael Collins Museum of Early Lunar Settlement. It was a popular tourist spot with all the tableaus and reenactments and, you should only excuse the expression, cheesy souvenirs you'd expect from such an establishment; I'd avoided it up until now mostly because I'd seen and heard most of it before, and much of what was left was the kind of crowd-pleasing foofaraw that tames and diminishes the actual experience I lived through for the consumption of folks who are primarily interested in tiring out their hyperactive kids. The dumbest of those was a pile of real Earth rocks, replacing the weight various early astronauts had taken from the Moon; ha ha ha, stop, I'm dying here. The most offensive was a kids' exhibit narrated by a cartoon-character early de-

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velopment engineer; he spoke with a cornball rural accent, had comic-opera patches on the knees of his moonsuit, and seemed to have an I.Q. of about five.

Another annoying thing about frontiers: when they're not frontiers anymore, the civilizations that move in like to think that the people who came first were stupid.

But when I found pictures of myself, in an exhibit on the development programs, and pointed them out to an attendant, it was fairly easy to talk the curators into letting me into their archives for a look at certain other materials that hadn't seen the light of day for almost twenty years. They were taped interviews, thirty years old now, with a number of the old guys and gals, talking about their experiences in the days of early development: the majority of those had been conducted here on the Moon, but others had taken place on Earth or Mars or wherever else any of those old farts ended up. I felt vaguely insulted that they hadn't tried to contact me; maybe they had, and my wife, anticipating my reluctance, had turned them away. I wondered if I should have felt annoyed by that. I wondered too if my annoyance at the taming of the Moon had something to do with the disquieting sensation of becoming ancient history while you're still alive to remember it.

There were about ten thousand hours of interviews; even if my health remained stable long enough for me to listen to them all, my savings would run out far sooner. But they were indexed, and audio-search is a wonderful thing. I typed in "Minnie" and got several dozen references to small things, almost as many references to Mickey's rodent girlfriend, and a bunch of stories about a project engineer, from after my time, who had also been blessed with that particular first name. (To believe the transcripts, she spent all her waking hours saying impossibly cute things that her friends and colleagues would remember and be compelled to repeat decades later; what a bloody pixie.) I typed in "Earl" and, though it felt silly, "Miles", and got a similar collection of irrelevancies—many references to miles, thus proving conclusively that as recently as thirty years ago the adoption of the metric system hadn't yet succeeded in wiping out any less elegant but still fondly remembered forms of measurement. After that, temporarily stuck, I typed in my own name, first and last, and was rewarded with a fine selection of embarrassing anecdotes from folks who recalled what a humorless little pissant I had been way back then. All of this took hours; I had to listen to each of these references, if only for a second or two, just to know for sure what was being talked about, and I confess that, in between a number of bathroom breaks I would have considered unlikely as a younger man, I more than once forgot what I was supposedly looking for long enough to enjoy a few moments with old voices I hadn't heard for longer than most lunar residents had been alive.

I then cross-referenced by the names of the various people who were along on that first Sunday night trip to Minnie and Earl's. "George Peterson" got me nothing of obvious value. "Carrie Aldrin" and "Peter Rawlik", ditto. Nor did the other names. There were references, but nothing I particularly needed.

Feeling tired, I sat there drumming my fingertips on the tabletop. The museum was closing soon. The research had exhausted my limited stores of strength; I didn't think I could do this many days in a row. But I knew there was something here. There had to be. Even if there was a conspiracy of silence—organized or accidental—the mere existence of that unassuming little house had left too great a footprint on our lives.

I thought about details that Claire had found particularly affecting.

And then I typed "Yams".

Seventy years ago, suffering from a

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truly epic sense of dislocation that made everything happening to me seem like bits of stage business performed by actors in a play whose author had taken care to omit all the important exposition, I descended a creaky flight of wooden stairs, to join my colleagues in Minnie and Earl's living room. I was the last to come down, of course; everybody else was already gathered around the three flowery-print sofas, munching on finger foods as they chatted up a storm. The women were in soft cottony dresses, the men in starched trousers and button-downs. They all clapped and cheered as I made my appearance, a reaction that brought an unwelcome blush to my cheeks. It was no wonder; I was a little withdrawn to begin with, back then, and the impossible context had me so off-center that all my defenses had turned to powder.

It was a homey place, though: brightly lit, with a burning fireplace, an array of glass shelving covered with a selection of homemade pottery, plants and flowers in every available nook, an upright piano, a bar that did not dominate the room, and an array of framed photographs on the wall behind the couch. There was no TV or hytex. I glanced at the photographs and moved toward them, hungry for data.

Then Earl rose from his easy chair and came around the coffee table, with a gruff, "Plenty of time to look around, son. Let me take care of you."

"That's—" I said. I was still not managing complete sentences, most of the time.

He took me by the arm, brought me over to the bar, and sat me down on a stool. "Like I said, plenty of time. You're like most first-timers, you're probably in dire need of a drink. We can take care of that first and then get acquainted." He moved around the bar, slung a towel over his shoulder, and said: "What'll it be, pilgrim?"

Thank God I recognized the reference. If I hadn't—if it had just been another inexplicable element of a day already crammed with them—my head would have exploded from the effort of figuring out why I was being called a pilgrim. "A . . . Sea of Tranquility?"

"Man after my own heart," Earl said, flashing a grin as he compiled an impressive array of ingredients in a blender. "Always drink the local drink, son. As my daddy put it, there's no point in going anywhere if you just get drunk the same way you can at home. Which is where, by the way?"

I said, "What?"

"You missed the segue. I was asking you where you were from."

It seemed a perfect opportunity. "You first."

He chuckled. "Oh, the wife and I been here long enough, you might as well say we're from here. Great place to retire, isn't it? The old big blue marble hanging up there all day and all night?"

"I suppose," I said.

"You suppose," he said, raising an eyebrow at the concoction taking shape in his blender. "That's awful noncommittal of you. Can't you even admit to liking the view?"

"I admit to it," I said.

"But you're not enthused. You know, there's an old joke about a fella from New York and a fella from New Jersey. And the fella from New York is always bragging on his town, talking about Broadway, and the Empire State Building, and Central Park, and so on, and just as often saying terrible things about how ugly things are on the Jersey side of the river. And the fella from Jersey finally gets fed up, and says, all right, I've had enough of this, I want you to say one thing, just one thing, about New Jersey that's better than anything you can say about Manhattan. And the fella from New York says, No problem. The view."

I didn't laugh, but I did smile.

"That's what's so great about this place," he concluded. "The view. Moon's pretty nice to look at for folks on Earth—and a godsend for bad poets,

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too, what with june-moon-spoon and all—but as views go, it can't hold a candle to the one we have, looking back. So don't give me any supposes. Own up to what you think."

"It's a great view," I said, this time with conviction, as he handed my drink. Then I asked the big question another way: "How did you arrange it?"

"You ought to know better than that, son. We didn't arrange it. We just took advantage of it. Nothing like a scenic overlook to give zip to your real estate. So answer me. Where are you from?"

Acutely aware that more than a minute had passed since I'd asked him the same question, and that no answer seemed to be forthcoming, I was also too trapped by simple courtesy to press the issue. "San Francisco."

He whistled. "I've seen pictures of San Francisco. Looks like a beautiful town."

"It is," I said.

"You actually climb those hills in Earth gravity?"

"I used to run up Leavenworth every morning at dawn."

"Leavenworth's the big steep one that heads down to the bay?"

"One of them," I said.

"And you ran up that hill? At dawn? Every day?"

"Yup."

"You have a really obsessive personality, don't you, son?"

I shrugged. "About some things, I suppose."

"Only about some things?"

"That's what being obsessive means, right?"

"Ah, well. Nothing wrong about being obsessive, as long as you're not a fanatic about it. Want me to freshen up that drink?"

I felt absolutely no alcoholic effect at all. "Maybe you better."

I tried to turn the conversation back to where he was from, but somehow I didn't get a chance, because that's when Minnie took me by the hand and dragged me over to the wall of family photos. There were pictures of them smiling on the couch, pictures of them lounging together in the backyard, pictures of them standing proudly before their home. There were a large number of photos that used Earth as a backdrop. Only four photos showed them with other people, all from the last century: in one, they sat at their dining table with a surprised-looking Neil Armstrong and Buzz Aldrin; in another, they sat on their porch swing chatting with Carl Sagan; in a third, Minnie was being enthusiastically hugged by Isaac Asimov; the fourth showed Earl playing the upright piano while Minnie sat beside him and a tall, thin blonde man with androgynous features and two differently-colored eyes serenaded them both. The last figure was the only one I didn't recognize immediately; by the time somebody finally clued me in, several visits later, I would be far too jaded to engage in the spit-take it would have merited any other time.

I wanted to ask Minnie about the photos with the people I recognized, but then Peter and Earl dragged me downstairs to take a look at Earl's model train set, a rural landscape incorporating four lines and six separate small towns. It was a remarkably detailed piece of work, but I was most impressed with the small miracle of engineering that induced four heavy chains to pull it out of the way whenever Earl pulled a small cord. This handily revealed the pool table. Earl whipped Peter two games out of three, then challenged me; I'm fairly good at pool, but I was understandably off my game that afternoon, and missed every single shot. When Carrie Aldrin No Relation came down to challenge Earl, he mimed terror. It was a genial hour, totally devoted to content-free conversation—and any attempt I made to bring up the questions that burned in my breast was terminated without apparent malice.

Back upstairs. The dog nosing at my hand. Minnie noting that he liked me.

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Minnie not saying anything about the son whose room we'd changed in, the one who'd died "in the war". A very real heartbreak about the way her eyes grew distant at that moment. I asked which war, and she smiled sadly: "There's only been one war, dear—and it doesn't really matter what you call it." Nikki patting her hand. Oscar telling a mildly funny anecdote from his childhood, Minnie asking him to tell her the one about the next-door neighbors again. I brought up the photo of Minnie and Earl with Neal Armstrong and Buzz Aldrin, and Minnie clucked that they had been such nice boys.

Paranoia hit. "Ever hear of Ray Bradbury?"

She smiled with real affection. "Oh, yes. We only met him once or twice, but he was genuinely sweet. I miss him."

"So you met him, too."

"We've met a lot of people, apricot. Why? Is he a relation?"

"Just an old-time writer I like," I said.

"Ahhhhhh."

"In fact," I said, "one story of his I particularly like was called 'Mars is Heaven'."

She sipped her tea. "Don't know that one."

"It's about a manned expedition to Mars—written while that was still in the future, you understand. And when the astronauts get there they discover a charming, rustic, old-fashioned American small town, filled with sweet old folks they remember from their childhoods. It's the last thing they expect, but after a while they grow comfortable with it. They even jump to the conclusion that Mars is the site of the afterlife. Except it's not. The sweet old folks are aliens in disguise, and they're lulling all these gullible earthlings into a false sense of security so they can be killed at leisure."

My words had been hesitantly spoken, less out of concern for Minnie's feelings than those of my colleagues. Their faces were blank, unreadable, masking emotions that could have been anything from anger to amusement. I will admit that for a split second there, my paranoia reaching heights it had never known before (or thank God, since), I half-expected George and Oscar and Maxine to morph into the hideously tentacled bug-eyed monsters who had taken their places immediately after eating their brains. Then the moment passed, and the silence continued to hang heavily in the room, and any genuine apprehension I might have felt gave way to an embarrassment of more mundane proportions. After all—whatever the explanation for all this might have been—I'd just been unforgivably rude to a person who had only been gracious and charming toward me.

She showed no anger, no sign that she took it personally. "I remember that one now, honey. I'm afraid I didn't like it as much as some of Ray's other efforts. Among other things, it seemed pretty unreasonable to me that critters advanced enough to pull off that kind of masquerade would have nothing better to do with their lives to eat nice folks who came calling. But then, he also wrote a story about a baby that starts killing as soon as it leaves the womb, and I prefer to believe that infants, given sufficient understanding and affection, soon learn that the universe outside the womb isn't that dark and cold a place after all. Given half a chance, they might even grow up . . . and it's a wonderful process to watch."

I had nothing to say to that.

She sipped her tea again, one pinky finger extended in the most unselfconscious manner imaginable, just as if she couldn't fathom drinking her tea any other way, then spoke brightly, with perfect timing: "But if you stay the night, I'll be sure to put you in the room with all the pods."

There was a moment of silence, with every face in the room—including those of Earl and Peter and Carrie, who had just come up from downstairs—as dis-

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tinguishedly impassive as a granite bust of some forefather you had never heard of.

Then I averted my eyes, trying to hide the smile as it began to spread on my face.

Then somebody made a helpless noise, and we all exploded with laughter.

Seventy years later:

If every land ever settled by human beings has its garden spots, then every land ever settled by human beings has its hovels. This is true even of frontiers that have become theme parks. I had spent much of this return to the world I had once known wandering through a brightly-lit, comfortably-upholstered tourist paradise—the kind of ersatz environment common to all overdeveloped places, that is less an expression of local character than a determined struggle to ensure the total eradication of anything resembling local character. But now I was headed toward a place that would never be printed on a postcard, that would never be on the tours, that existed on tourist maps only as the first, best sign that those looking for easy travelling have just made a disastrous wrong turn.

It was on Farside, of course. Most tourist destinations, and higher-end habitats, are on Nearside, which comes equipped with a nice blue planet to look at. Granted that even on Nearside the view is considered a thing for tourists, and that most folks who live here live underground and like to brag to each other about how long they've gone without Earthgazing—our ancestral ties are still part of us, and the mere presence of Earth, seen or unseen, is so inherently comforting that most normal people with a choice pick Nearside. Farside, by comparison, caters almost exclusively to hazardous industries and folks who don't want that nice blue planet messing up the stark emptiness of their sky—a select group of people that includes a small number of astronomers at the Frank Drake Observatory, and a large number of assorted perverts and geeks and misanthropes. The wild frontier of the fantasies comes closest to being a reality here—the hemisphere has some heavy-industry settlements that advertise their crime rates as a matter of civic pride.

And then there are the haunts of those who find even those places too civilized for their tastes. The mountains and craters of Farside are dotted with the little boxy single-person habitats of folks who have turned their back not only on the home planet but also the rest of humanity as well. Some of those huddle inside their self-imposed solitary confinement for weeks or months on end, emerging only to retrieve their supply drops or enforce the warning their radios transmit on infinite loop: that they don't want visitors and that all trespassers should expect to be shot. They're all eccentric, but some are crazy and a significant percentage of them are clinically insane. They're not the kind of folks the sane visit just for local color.

I landed my rented skimmer on a ridge overlooking an oblong metal box with a roof marked by a glowing ten-digit registration number. It was night here, and nobody who lived in such a glorified house trailer would have been considerate enough to provide any outside lighting for visitors, so those lit digits provided the only ground-level rebuttal to starfield up above; it was a inadequate rebuttal at best, which left the ground on all sides an ocean of undifferentiated inky blackness. I could carry my own lamp, of course, but I didn't want to negotiate the walk from my skimmer to the habitat's front door if the reception I met there required a hasty retreat; I wasn't very capable of hasty retreats, these days.

So I just sat in my skimmer and transmitted the repeating loop: *Walter Stearns. I desperately need to speak to Walter Stearns. Walter Stearns. I des-*

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perately need to speak to Walter Stearns. Walter Stearns. I desperately need to speak to Walter Stearns. Walter Stearns. I desperately need to speak to Walter Stearns. It was the emergency frequency that all of these live-alones are required to keep open 24-7, but there was no guarantee Stearns was listening—and since I was not in distress, I was not really legally entitled to use it. But I didn't care; Stearns was the best lead I had yet.

It was only two hours before a voice like a mouth full of steel wool finally responded: "Go away."

"I won't be long, Mr. Stearns. We need to talk."

"You need to talk. I need you to go away."

"It's about Minnie and Earl, Mr. Stearns."

There was a pause. "Who?"

The pause had seemed a hair too long to mean mere puzzlement. "Minnie and Earl. From the development days. You remember them, don't you?"

"I never knew any Minnie and Earl," he said. "Go away."

"I listened to the tapes you made for the Museum, Mr. Stearns."

The anger in his hoarse, dusty old voice was still building. "I made those tapes when I was still talking to people. And there's nothing in them about any Minnie or Earl."

"No," I said, "there's not. Nobody mentioned Minnie and Earl by name, not you, and not anybody else who participated. But you still remember them. It took me several days to track you down, Mr. Stearns. We weren't here at the same time, but we still had Minnie and Earl in common."

"I have nothing to say to you," he said, with a new shrillness in his voice. "I'm an old man. I don't want to be bothered. Go away."

My cheeks ached from the size of my triumphant grin. "I brought yams."

There was nothing on the other end but the sibilant hiss of background radiation. It lasted just long enough to persuade me that my trump card had been nothing of the kind; he had shut down or smashed his receiver, or simply turned his back to it, so he could sit there in his little cage waiting for the big bad outsider to get tired and leave.

Then he said: "Yams."

Twenty-four percent of the people who contributed to the Museum's oral history had mentioned yams at least once. They had talked about the processing of basic food shipments from home, and slipped yams into their lists of the kind of items received; they had conversely cited yams as the kind of food that the folks back home had never once thought of sending; they had related anecdotes about funny things this coworker or that coworker had said at dinner, over a nice steaming plate of yams. They had mentioned yams and they had moved on, behaving as if it was just another background detail mentioned only to provide their colorful reminiscences the right degree of persuasive verisimilitude. Anybody not from those days who noticed the strange recurring theme might have imagined it a statistical oddity or an in-joke of some kind. For anybody who had been to Minnie and Earl's—and tasted the delicately seasoned yams she served so frequently—it was something more: a strange form of confirmation.

When Stearns spoke again, his voice still rasped of disuse, but it also possessed a light quality that hadn't been there before. "They've been gone a long time. I'm not sure I know what to tell you."

"I checked your records," I said. "You've been on the Moon continuously since those days; you went straight from the development teams to the early settlements to the colonies that followed. You've probably been here nonstop longer than anybody else living or dead. If anybody can give me an idea what happened to them, it's you."

More silence.

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"Please," I said.

And then he muttered a cuss word that had passed out of the vernacular forty years earlier. "All right, damn you. But you won't find them. I don't think anybody will ever find them."

Seventy years earlier:

We were there for about two more hours before George took me aside, said he needed to speak to me in private, and directed me to wait for him in the backyard.

The backyard was nice.

I've always hated that word. *Nice.* It means nothing. Describing people, it can mean the most distant politeness, or the most compassionate warmth; it can mean civility and it can mean charity and it can mean grace and it can mean friendship. Those things may be similar, but they're not synonyms; when the same word is used to describe all of them, then that word means nothing. It means even less when describing places. So what if the backyard was nice? Was it just comfortable, and well-tended, or was it a place that reinvigorated you with every breath? How can you leave it at "nice" and possibly imagine that you've done the job?

Nice. Feh.

But that's exactly what this backyard was.

It was a couple of acres of trimmed green lawn, bordered by the white picket fence that signalled the beginning of vacuum. A quarter-circle of bright red roses marked each of the two rear corners; between them, bees hovered lazily over a semicircular garden heavy on towering orchids and sunflowers. The painted white rocks which bordered that garden were arranged in a perfect line, none of them even a millimeter out of place, none of them irregular enough to shame the conformity that characterized the relationship among all the others. There was a single apple tree, which hugged the rear of the house so tightly that the occupants of the second floor might have been able to reach out their windows and grab their breakfast before they trudged off to the shower; there were enough fallen green apples to look picturesque, but not enough to look sloppy. There was a bench of multicolored polished stone at the base of the porch steps, duplicating the porch swing up above but somehow absolutely right in its position; and as I sat on that bench facing the nice backyard I breathed deep and I smelled things that I had almost forgotten I could smell—not just the distant charcoal reek of neighbors burning hamburgers in their own backyards, but lilacs, freshly cut grass, horse scent, and a cleansing whiff of rain. I sat there and I spotted squirrels, hummingbirds, monarch butterflies, and a belled calico cat that ran by, stopped, saw me, looked terribly confused in the way cats have, and then went on. I sat there and I breathed and after months of inhaling foot odor and antiseptics I found myself getting a buzz. It was intoxicating. It was invigorating. It was a shot of pure energy. It was joy. God help me, it was nice.

But it was also surrounded on all sides by a pitiless vacuum that, if real physics meant anything, should have claimed it in an instant. Perhaps it shouldn't have bothered me that much, by then; but it did.

The screen door slammed. Miles the dog bounded down the porch steps and, panting furiously, nudged my folded hands. I scratched him under the ears. He gave me the usual unconditional adoration of the golden retriever—I petted him, therefore I was God. Most panting dogs look like they're smiling (it's a major reason humans react so strongly to the species), but Miles, the canine slave to context, looked like he was enjoying the grand joke that everybody was playing at my expense. Maybe he was. Maybe he wasn't even really a dog . . .

The screen door opened and slammed. This time it was George, car-

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rying a couple of tall glasses filled with pink stuff and ice. He handed me one of the glasses; it was lemonade, of course. He sipped from the other one and said: "Minnie's cooking yams again. She's a miracle worker when it comes to yams. She does something with them, I don't know, but it's really—"

"You," I said wryly, "are enjoying this way too much."

"Aren't you?" he asked.

Miles the dog stared at the lemonade as if it was the most wondrous sight in the Universe. George dipped a finger into his drink and held it out so the mutt could have a taste. Miles adored him now. I was so off-center I almost felt betrayed. "Yeah. I guess I am. I like them."

"Pretty hard not to like them. They're nice people."

"But the situation is so insane—"

"Sanity," George said, "is a fluid concept. Think about how nuts Relativity sounded, the first time somebody explained it to you. Hell, think back to when you were a kid, and somebody first explained the mechanics of sex."

"George—"

He gave Miles another taste. "I can see you trying like mad to work this out. Compiling data, forming and rejecting theories, even concocting little experiments to test the accuracy of your senses. I know because I was once in your position, when I was brought out here for the first time, and I remember doing all the same things. But I now have a lot of experience in walking people through this, and I can probably save you a great deal of time and energy by completing your data and summarizing all of your likely theories."

I was too tired to glare at him anymore. "You can skip the data and theories and move on to the explanation. I promise you I won't mind."

"Yes, you would," he said, with absolute certainty. "Trust me, dealing with the established lines of inquiry is the only real way to get there.

"First, providing the raw data. One: This little homestead cannot be detected from Earth; our most powerful telescopes see nothing but dead moonscape here. Two: It, and the two old folks, have been here since at least Apollo; those photos of them with Armstrong and Aldrin are genuine. Three: There is nothing you can ask them that will get any kind of straight answer about who or what they are and why they're here. Four: We have no idea how they knew Asimov, Sagan, or Bradbury—but I promise you that those are not the most startling names you will hear them drop if you stick around long enough to get to know them. Five: We don't know how they maintain an earthlike environment in here. Six: About that mailbox—they do get delivery, on a daily basis, though no actual mailman has ever been detected, and none of the mail we've ever managed to sneak a peek at is the slightest bit interesting. It's all senior citizen magazines and grocery store circulars. Seven: They never seem to go shopping, but they always have an ample supply of food and other provisions. Eight (I am up to eight, right?): They haven't noticeably aged, not even the dog. Nine: they do understand every language we've sprung on them, but they give all their answers in Midwestern-American English. And ten: we have a group of folks from our project coming out here to visit just about every night of the week, on a rotating schedule that works out to just about once a week for each of us.

"So much for the raw data. The theories take longer to deal with. Let me go through all the ones you're likely to formulate." He peeled back a finger. "One: This is all just a practical joke perpetrated by your friends and colleagues in an all-out attempt to shock you out of your funk. We put it all together with spit and baling wire and some kind of elaborate special-effects trickery that's going to seem ridiculously obvious just as soon as you're done figuring it out. We went to all this effort, and spent the many billions of dollars it would have cost to get

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all these construction materials here, and developed entirely new technologies capable of holding in an atmosphere, and put it all together while you weren't looking, and along the way brought in a couple of convincing old folks from Central Casting, just so we could enjoy the look on your face. What a zany bunch of folks we are, huh?"

I felt myself blushing. "I'd considered that."

"And why not? It's a legitimate theory. Also a ridiculous one, but let's move on." He peeled back another finger. "Two: This is not a practical joke, but a test or psychological experiment of some kind, arranged by the brain boys back home. They put together all of this trickery, just to see how the average astronaut, isolated from home and normal societal context, reacts to situations that defy easy explanation and cannot be foreseen by even the most exhaustively-planned training. This particular explanation works especially well if you also factor in what we cleverly call the McGoohan Corollary—that is, the idea that we're not really on the Moon at all, but somewhere on Earth, possibly underground, where the real practical difficulty would lie in simulating not a quaint rural setting on a warm summer day, but instead the low-g, high-radiation, temperature-extreme vacuum that you gullibly believed you were walking around in, every single time you suited up. This theory is, of course, equally ridiculous, for many reasons—but we did have one guy about a year ago who stubbornly held on to it for almost a full week. Something about his psychological makeup just made it easier for him to accept that, over all the others, and we had to keep a close watch on him to stop him from trying to prove it with a nice unsuited walk. But from the way you're looking at me right now I don't think we're going to have the same problem with you. So.

"Assuming that this is not a joke, or a trick, or an experiment, or some lame phenomenon like that, that this situation you're experiencing is precisely what we have represented to you, then we are definitely looking at something beyond all terrestrial experience. Which brings us to Three." He peeled back another finger. "This is a first-contact situation. Minnie and Earl, and possibly Miles here, are aliens in disguise, or simulations constructed by aliens. They have created a friendly environment inside this picket fence, using technology we can only guess at—let's say an invisible bubble capable of filtering out radiation and retaining a breathable atmosphere while remaining permeable to confused bipeds in big clumsy moonsuits. And they have done so—why? To hide their true nature while they observe our progress? Possibly. But if so, it would be a lot more subtle to place their little farmhouse in Kansas, where it wouldn't seem so crazily out of place. To communicate us in terms we can accept? Possibly—except that couching those terms in such an insane context seems as counterproductive to genuine communication as their apparent decision to limit the substance of that communication to geriatric small talk. To make us comfortable with something familiar? Possibly—except that this kind of small mid-American home is familiar to only a small fraction of humanity, and it seems downright exotic to the many observers we've shuttled in from China, or India, or Saudi Arabia, or for that matter, Manhattan. To present us with a puzzle that we have to solve? Again, possibly—but since Minnie and Earl and Miles won't confirm or deny, it's also a possibility we won't be able to test unless somebody like yourself actually does come up with the great big magic epiphany. I'm not holding my breath. But I do reject any theory that they're hostile, including the 'Mars is Heaven' theory you already cited. Anybody capable of pulling this off must have resources that could mash us flat in the time it takes to sneeze."

Miles woofed. In context it seemed

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vaguely threatening.

"Four." Another finger. "Minnie and Earl are actually human, and Miles is actually canine. They come here from the future, or from an alternate universe, or from some previously-unknown subset of humanity that's been living among us all this time, hiding great and unfathomable powers that, blaaah blaah blaah, fill in the blank. And they're here, making their presence known—why? All the same subtheories that applied to alien visitors also apply to human agencies, and all the same objections as well. Nothing explains why they would deliberately couch such a maddening enigma in such, for lack of a more appropriate word, banal terms. It's a little like coming face to face with God and discovering that He really does look like a bearded old white guy in a robe; He might, for all I know, but I'm more religious than you probably think, and there's some part of me that absolutely refuses to believe it. He, or She, if you prefer, could do better than that. And so could anybody, human or alien, whose main purpose in coming here is to study us, or test us, or put on a show for us.

"You still with me?" he inquired.

"Go on," I growled. "I'll let you know if you leave anything out."

He peeled back another finger. "Five: I kind of like this one—Minnie and Earl, and by extension Miles, are not creatures of advanced technology, but of a completely different kind of natural phenomenon—let's say, for the sake of argument, a bizarre jog in the space-time continuum that allows a friendly but otherwise unremarkable couple living in Kansas or Wyoming or someplace like that to continue experiencing life down on the farm while in some way as miraculous to them as it seems to us, projecting an interactive version of themselves to this otherwise barren spot on the Moon. Since, as your little conversation with Earl established, they clearly know they're on the Moon, we would have to accept that they're unflappable enough to take this phenomenon at face value, but I've known enough Midwesterners to know that this is a genuine possibility.

"Six." Starting now on another hand. "Mentioned only so you can be assured I'm providing you an exhaustive list— a phenomenon one of your predecessors called the Law of Preservation of Home. He theorized that whenever human beings penetrate too far past their own natural habitat, into places sufficiently inhospitable to life, the Universe is forced to spontaneously generate something a little more congenial to compensate—the equivalent, I suppose, of magically whomping up a Holiday Inn with a swimming pool to greet explorers lost in the coldest reaches of Antarctica. He even said that the only reason we hadn't ever received reliable reports of this phenomenon on Earth is that we weren't ever sufficiently far from our natural habitat to activate it . . . but I can tell from the look on your face that you don't exactly buy this one either, so I'll set it aside and let you read the paper he wrote on the subject at your leisure."

"I don't think I will," I said.

"You ought to. It's a real hoot. But if you want to, I'll skip all the way to the end of the list, to the only explanation that ultimately makes any sense. Ready?"

"I'm waiting."

"All right. That explanation is—" he paused dramatically "—it doesn't matter."

There was a moment of pregnant silence.

I didn't explode; I was too shell-shocked to explode. Instead, I just said: "I sat through half a dozen bullshit theories for 'It doesn't matter'?"

"You had to, Max; it's the only way to get there. You had to learn the hard way that all of these propositions are either completely impossible or, for the time being, completely impossible to test—and we know this because the best minds on Earth have been working on the problem for as long as there's been a sustained human presence on the

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Moon. We've taken hair samples from Minnie's hairbrush. We've smuggled out stool samples from the dog. We've recorded our conversations with the old folks and studied every second of every tape from every possible angle. We've monitored the house for years on end, analyzed samples of the food and drink served in there, and exhaustively charted the health of everybody to go in or out. And all it's ever gotten us, in all these years of being frantic about it, is this—that as far as we can determine, Minnie and Earl are just a couple of friendly old folks who like having visitors."

"And that's it?"

"Why can't it be? Whether aliens, time travellers, displaced human beings, or natural phenomena—they're good listeners, and fine people, and they sure serve a good Sunday dinner. And if there must be things in the Universe we can't understand—well, then, it's sure comforting to know that some of them just want to be good neighbors. That's what I mean by saying it doesn't matter."

He stood up, stretched, took the kind of deep breath people only indulge in when they're truly luxuriating in the freshness of the air around them, and said: "Minnie and Earl expect some of the new folks to be a little pokey, getting used to the idea. They won't mind if you stay out here and smell the roses a while. Maybe when you come in, we'll talk a little more 'bout getting you scheduled for regular visitation. Minnie's already asked me about it—she seems to like you. God knows why." He winked, shot me in the chest with a pair of pretend six-shooters made from the index fingers of both hands, and went back inside, taking the dog with him. And I was alone in the nice backyard, serenaded by birdsong as I tried to decide how to reconcile my own rational hunger for explanations with the unquestioning acceptance that was being required of me.

Eventually, I came to the same conclusion George had; the only conclusion that was possible under the circumstances. It was a genuine phenomenon, that conclusion: a community of skeptics and rationalists and followers of the scientific method deciding that there were some things Man was having too good a time to know. Coming to think of Minnie and Earl as family didn't take much longer than that. For the next three years, until I left for my new job in the outer system, I went out to their place at least once, sometimes twice a week; I shot pool with Earl and chatted about relatives back home with Minnie; I'd tussled with Miles and helped with the dishes and joined them for long all-nighters talking about nothing in particular. I learned how to bake with the limited facilities we had at Base, so I could bring my own cookies to her feasts. I came to revel in standing on a creaky front porch beneath a bug lamp, sipping grape juice as I joined Minnie in yet another awful rendition of "Anatevka." Occasionally I glanced at the big blue cradle of civilization hanging in the sky, remembered for the fiftieth or sixtieth or one hundredth time that none of this had any right to be happening, and reminded myself for the fiftieth or sixtieth or one hundredth time that the only sane response was to continue carrying the tune. I came to think of Minnie and Earl as the real reason we were on the Moon, and I came to understand one of the major reasons we were all so bloody careful to keep it a secret—because the needy masses of Earth, who were at that point still agitating about all the time and money spent on the space program, would not have been mollified by the knowledge that all those billions were being spent, in part, so that a few of the best and the brightest could indulge themselves in sing-alongs and wiener dog cookouts.

I know it doesn't sound much like a frontier. It wasn't, not inside the picket fence. Outside, it remained dangerous and backbreaking work. We lost five

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separate people while I was there; two to blowouts, one to a collapsing crane, one to a careless tumble off a crater rim, and one to suicide (she, alas, had not been to Minnie and Earl's yet). We had injuries every week, shortages every day, and crises just about every hour. Most of the time, we seemed to lose ground—and even when we didn't, we lived with the knowledge that all of our work and all of our dedication could be thrown in the toilet the first time there was a political shift back home. There was no reason for any of us to believe that we were actually accomplishing what we were there to do—but somehow, with Minnie and Earl there, hosting a different group every night, it was impossible to come to any other conclusion. They liked us. They believed in us. They were sure that we were worth their time and effort. And they expected us to be around for a long, long time . . . just like they had been.

I suppose that's another reason why I was so determined to find them now. Because I didn't know what it said about the people we'd become that they weren't around keeping us company anymore.

I was in a jail cell for forty-eight hours once. Never mind why; it's a stupid story. The cell itself wasn't the sort of thing I expected from movies and television; it was brightly lit, free of vermin, and devoid of any steel bars to grip obsessively while cursing the guards and bemoaning the injustice that had brought me there. It was just a locked room with a steel door, a working toilet, a clean sink, a soft bed, and absolutely nothing else. If I had been able to come and go at will it might have been an acceptable cheap hotel room. Since I was stuck there, without anything to do or anybody to talk to, I spent those forty-eight hours going very quietly insane.

The habitat module of Walter Stearns was a lot like that cell, expanded to accommodate a storage closet, a food locker, and a kitchenette; it was that stark, that empty. There were no decorations on the walls, no personal items, no hytex or music system I could see, nothing to read and nothing to do. It lost its charm for me within thirty seconds. Stearns had been living there for sixteen years: a self-imposed prison sentence that might have been expiation for the sin of living past his era.

The man himself moved with what seemed glacial slowness, like a wind-up toy about to stop and fall over. He dragged one leg, but if that was a legacy of a stroke—and an explanation for why he chose to live as he did—there was no telltale slur to his speech to corroborate it. Whatever the reason might have been, I couldn't help regarding him with the embarrassed pity one old man feels toward another the same age who hasn't weathered his own years nearly as well.

He accepted my proffered can of yams with a sour grin and gave me a mug of some foul-smelling brown stuff in return. Then he poured some for himself and shuffled to the edge of his bed and sat down with a grunt. "I'm not a hermit," he said, defensively.

"I didn't use the word," I told him.

"I didn't set out to be a hermit." he went on, as if he hadn't heard me. "Nobody sets out to be a hermit. Nobody turns his back on the damned race unless he has some reason to be fed up. I'm not fed up. I just don't know any alternative. It's the only way I know to let the Moon be the Moon."

He sipped some of the foul-smelling brown stuff and gestured for me to do the same. Out of politeness, I sipped from my own cup. It tasted worse than it smelled, and had a consistency like sand floating in vinegar. Somehow I didn't choke. "Let the Moon be the Moon?"

"They opened a casino in Shepardsville. I went to see it. It's a big luxury hotel with a floor show; trained white tigers jumping through flaming hoops for the pleasure of a pretty young trainer

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in a spangled bra and panties. The casino room is oval-shaped, and the walls are alive with animated holography of wild horses running around and around and around and around, without stop, twenty-four hours a day. There are night clubs with singers and dancers, and an amusement park with rides for the kids. I sat there and I watched the gamblers bent over their tables and the barflies bent over their drinks and I had to remind myself that I was on the Moon—that just being here at all was a miracle that would have had most past civilizations consider us gods. But all these people, all around me, couldn't feel it. They'd built a palace in a place where no palace had ever been and they'd sucked all the magic and all the wonder all the way out of it." He took a deep breath, and sipped some more of his contemptible drink. "It scared me. It made me want to live somewhere where I could still feel the Moon being the Moon. So I wouldn't be some useless . . . relic who didn't know where he was half the time."

The self-pity had wormed its way into his voice so late that I almost didn't catch it. "It must get lonely," I ventured.

"Annnh. Sometimes I put on my moonsuit and go outside, just to stand there. It's so silent there that I can almost hear the breath of God. And I remember that it's the Moon—the Moon, dammit. Not some five-star hotel. The Moon. A little bit of that and I don't mind being a little lonely the rest of the time. Is that crazy? Is that being a hermit?"

I gave the only answer I could. "I don't know."

He made a hmmmph noise, got up, and carried his mug over to the sink. A few moments cleaning it out and he returned, his lips curled into a half-smile, his eyes focused on some far-off time and place. "The breath of God," he murmured.

"Yams," I prompted.

"You caught that, huh? Been a while since somebody caught that. It's not the sort of thing people catch unless they were there. Unless they remember her."

"Was that by design?"

"You mean, was it some kind of fiendish secret code? Naah. More like a shared joke. We knew by then that nobody would believe us if we actually talked about Minnie and Earl. They were that forgotten. So we dropped yams into our early-settlement stories. A little way of saying, hey, we remember the old lady. She sure did love to cook those yams."

"With her special seasoning." I said. "And those rolls she baked."

"Uh-huh." He licked his lips, and I almost fell into the trap of considering that inutterably sad . . . until I realized that I was doing the same thing. "Used to try to mix one of Earl's special cocktails, but I never could get them right. Got all the ingredients. Mixed 'em the way he showed me. Never got 'em to taste right. Figure he had some kind of technological edge he wasn't showing us. Real alien superscience, applied to bartending. Or maybe I just can't replace the personality of the bartender. But they were good drinks. I've got to give him that."

We sat together in silence for a while, each lost in the sights and sounds of a day long gone. After a long time, I almost whispered it: "Where did they go, Walter?"

His eyes didn't focus: "I don't know where they are. I don't know what happened to them."

"Start with when you last visited them."

"Oh, that was years and years and years ago." He lowered his head and addressed the floor. "But you know how it is. You have relatives, friends, old folks very important to you. Folks you see every week or so, folks who become a major part of who you are. Then you get busy with other things and you lose touch. I lost touch when the settlement boom hit, and there was always some

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other place to be, some other job that needed to be done; I couldn't spare one night a week gabbing with old folks just because I happened to love them. After all, they'd always be there, right? By the time I thought of looking them up again, it turned out that everybody else had neglected them too. There was no sign of the house and no way of knowing how long they'd been gone."

I was appalled. "So you're saying that Minnie and Earl moved away because of . . . neglect?"

"Naaah. That's only why they didn't say goodbye. I don't think it has a damn thing to do with why they moved away; just why we didn't notice. I guess that's another reason why nobody likes to talk about them. We're all just too damn ashamed."

"Why do you think they moved, Walter?"

He swallowed another mouthful of his vile brew, and addressed the floor some more, not seeing me, not seeing the exile he'd chosen for himself, not seeing anything but a tiny little window of his past. "I keep thinking of that casino," he murmured. "There was a rotating restaurant on the top floor of the hotel. Showed you the landscape, with all the billboards and amusement parks—and above it all, in the place where all the advertisers hope you're going to forget to look, Mother Earth herself. It was a burlesque and it was boring. And I also keep thinking of that little house, out in the middle of nowhere, with the picket fence and the golden retriever dog . . . and the two sweet old people . . . and the more I compare one thought to the other, the more I realize that I don't blame them for going away. They saw that on the Moon we were building, they wouldn't be miraculous any more."

"They had a perfectly maintained little environment—"

"We have a perfectly maintained little environment. We have parks with grass. We have roller coasters and golf courses. We have people with dogs. We even got rotating restaurants and magic acts with tigers. Give us a few more years up here and we'll probably work out some kind of magic trick to do away with the domes and the bulkheads and keep in an atmosphere with nothing but a picket fence. We'll have houses like theirs springing up all over the place. The one thing we don't have is the Moon being the Moon. Why would they want to stay here?" His voice, which had been rising throughout his little tired, rose to a shriek with that last question; he hurled his mug against the wall, but it was made of some indestructible ceramic that refused to shatter. It just tumbled to the floor, and skittered under the bunk, spinning in place just long enough to mock him for his empty display of anger. He looked at me, focused, and let me know with a look that our audience was over. "What would be left for them?"

I searched some more, tracking down another five or six oldsters still capable of talking about the old days, as well as half a dozen children or grandchildren of same willing to speak to me about the memories the old folks had left behind, but my interview with Walter Stearns was really the end of it; by the time I left his habitat, I knew that my efforts were futile. I saw that even those willing to talk to me weren't going to be able to tell me more than he had . . . and I turned out to be correct about that. Minnie and Earl had moved out, all right, and there was no forwarding address to be had.

I was also tired: bone-weary in a way that could have been just a normal symptom of age and could have been despair that I had not found what I so desperately needed to find and could have been the harbinger of my last remaining days. Whatever it was, I just didn't have the energy to keep going that much longer . . . and I knew that the only real place for me was the bed I had shared with my dear Claire.

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On the night before I flew back I had some money left over, so I went to see the musical *Ceres* at New Broadway. I confess I found it dreadful—like most old farts, I can't fathom music produced after the first three decades of my life—but it was definitely elaborate, with a cast of lithe and gymnastic young dancers in silvery jumpsuits leaping about in a slow-motion ballet that took full advantage of the special opportunities afforded by lunar gravity. At one point the show even simulated free fall, thanks to invisible filaments that criss-crossed the stage allowing the dancers to glide from place to place like objects ruled only by their own mass and momentum. The playbill said that one of the performers, never mind which one, was not a real human being, but a holographic projection artfully integrated with the rest of the performers. I couldn't discern the fake, but I couldn't find it in myself to be impressed. We were a few flimsy bulkheads and half a kilometer from lunar vacuum, and to me, that was the real story . . . even if nobody else in the audience of hundreds could see it.

I moved out of my hotel. I tipped my concierge, who hadn't found me anything about Minnie and Earl but had provided all the other amenities I'd asked for. I bought some stupid souvenirs for the grandchildren, and boarded my flight back to Earth.

After about an hour I went up to the passenger lounge, occupied by two intensely-arguing businesswomen, a child playing a handheld hytex game, and a bored-looking thin man with a shiny head. Nobody was looking out the panoramic window, not even me. I closed my eyes and pretended that the view wasn't there. Instead I thought of the time Earl had decided he wanted to fly a kite. That was a major moment. He built it out of newspapers he got from somewhere, and sat in his backyard letting out more than five hundred meters of line; though the string and the kite extended far beyond the atmospheric picket-fence perimeter, it had still swooped and sailed like an object enjoying the robust winds it would have known, achieving that altitude on Earth. That, of course, had been another impossibility . . . but my colleagues and I had been so inured to such things by then that we simply shrugged and enjoyed the moment as it came.

I badly wanted to fly a kite.

I badly wanted to know that Minnie and Earl had not left thinking poorly of us.

I didn't think they were dead. They weren't the kind of people who died. But they were living somewhere else, someplace far away—and if the human race was lucky it was somewhere in the solar system. Maybe, even now, while I rode back to face however much time I had left, there was a mindboggling little secret being kept by the construction teams building those habitats out near the Jovian moons; maybe some of those physicists and engineers were taking time out from a week of dangerous and backbreaking labor to spend a few hours in the company of an old man and old woman whose deepest spoken insight about the massive planet that graces their sky was how it presented one hell of a lovely view. Maybe the same thing happened when Anderson and Santiago hitched a ride on the comet that now bears their names—and maybe there's a little cottage halfway up the slope of Olympus Mons where the Mars colonists go whenever they need a little down-home hospitality. I would have been happy with all of those possibilities. I would have felt the weight of years fall from my bones in an instant, if I just knew that there was still room for Minnie and Earl in the theme-park future we seemed to be building.

Then something, maybe chance, maybe instinct, made me look out the window.

And my poor, slowly failing heart almost stopped right then.

Because Miles, the golden retriever,

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was pacing us.

He ran alongside the shuttle, keeping up with the lounge window, his lolling pink tongue and long floppy ears trailing behind him like banners driven by some unseen (and patently impossible) breeze. He ran as if in slow motion, his feet pawing a ground that wasn't there, his muscles rippling along his side, his muzzle foaming with perspiration. His perpetually laughing expression, so typical of his breed, was not so much the look of an animal merely panting with exertion, but the genuine mirth of a creature aware that it has just pulled off a joke of truly epic proportions. As I stared at him, too dumbstruck to whoop and holler and point him out to my fellow passengers, he turned his head, met my gaze with soulful brown eyes, and did something I've never seen any other golden retriever do, before or since.

He winked.

Then he faced forward, lowered his head, and sped up, leaving us far behind.

I whirled and scanned the lounge, to see if any of my fellow passengers had seen him. The two businesswomen had stopped arguing, and were now giggling over a private joke of some kind. The kid was still intently focused on his game. But the eyes of the man with the shiny head were very large and very round. He stared at me, found in my broad smile confirmation that he hadn't been hallucinating, and tried to speak. "That," he said. And "Was." And after several attempts, "A dog."

He might have gone on from there given another hour or so of trying.

I knew exactly how he felt, of course. I had been in the same place, once, seventy years ago.

Now, for a while, I felt like I was twelve again.

I rose from my seat, crossed the lounge, and took the chair facing the man with the shiny head. He was wide-eyed, like a man who saw me, a total stranger, as the only fixed constant in his universe. That made me feel young, too.

I said, "Let me tell you a little bit about some old friends of mine." □

This one's for Jerry and Kathy Oltion, the Minnie and Earl of the future.

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Pinch Me—I'm Fusing!

Mark S. Derzon

What is a z-pinch? And why are z-pinches a promising fusion power technology?

The process of combining nuclei (the protons and neutrons inside an atomic nucleus) together with a release of kinetic energy is called fusion. This process powers the Sun, contributes to the world stockpile of weapons of mass destruction, and may one day generate safe, clean electrical power. Understanding the intricacies of fusion power, promised for 50 years, is sometimes difficult because there are a number of ways of doing it.

There is hot fusion, cold fusion and con-fusion. Hot fusion is what powers suns through the conversion of mass energy to kinetic energy. Cold fusion generates con-fusion and nobody really knows what it is. There does seem to be something going on here; I just don't know what. Apparently some experimenters get energy out of a process many call "cold fusion", but no one seems to know what it is, or how to do it reliably. It is not getting much attention from the mainline physics community.

Even so, no one is generating electrical power for you and me with either method. In this article, I will point out some basic features of the mainstream approaches taken to hot fusion power, and describe why "z-pinches" are worth pursuing as a driver for a power reactor and may one day generate electrical power for mankind.

What is fusion and why should we care?

Fusion of two or more nuclei can bring about an exchange of energy from one form to another. Einstein's famous formula $E=mc^2$ (E means energy, m is mass, and c the speed of light) represents the basis for nuclear power. It means that energy can be interchanged with mass. Fusion reactions, or collisions, allow nuclei to interact and come out of the collision changed. The mass energy can be reduced after a collision and the kinetic energy—the energy associated with the motion of the outgoing particles—is increased by an amount equal to the reduction in mass. Once you convert nuclear mass to kinetic energy, the kinetic energy of the outgoing particles can be converted into "thermal energy." This thermal energy is the randomly oriented bouncing together of molecules we call heat. In this context, it could be used to boil water and drive steam turbines for generating electrical power.

The concept of converting mass energy to kinetic energy is illustrated in the binding energy per nucleon curve shown in Fig. 1. Nuclei whose binding energy per nucleon is lower than iron may be reconfigured into more stable nuclei and the difference in binding energy of the whole system can be observed as thermal energy or heat.

The reactions that are typically con-

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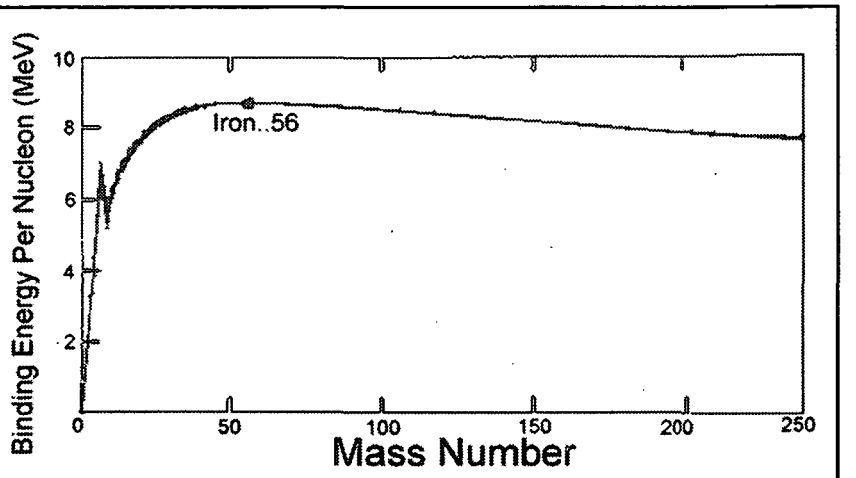

* Adapted from http://library.thinkquest.org/3471/noNetscape/mass_binding.html

sidered for powering fusion reactors are those which involve deuterium ($_1H^2$, 1 proton and 1 neutron) and tritium ($_1H^3$, 1 proton and 2 neutrons). This is the reaction most frequently considered to be the basic fusion reaction for a reactor because the fusion cross section, or interaction probability, is highest for these two nuclei—by a lot. Fuel cycles other than the DT cycle are called "advanced" fuel cycles and it is much harder to create the necessary plasma physics conditions. It is generally considered easier to create the necessary tritium than to create an advanced fuel cycle machine. The tritium can be "bred" by surrounding the fusioning material with a lot of lithium. This is because the neutrons leaving the fuel interact with lithium; the lithium then splits—creating tritium and helium as by-products.

What this means is that there must be a lot of lithium around the plasma to interact with the neutrons emitted during the fusion process. It is these neutrons which will cause the bulk of the material damage and long-lived (read as requiring long-term disposal) radioactivity.

The two methods most heavily funded for pursuing fusion energy are magnetic-confinement fusion energy (MFE) and inertial-confinement fusion energy (IFE). In MFE plasmas, a magnetic bottle contains a high-temperature deuterium-tritium plasma at moderate particle densities for long times (>millisecond). IFE plasmas use a capsule filled with a deuterium-tritium mixture. This capsule is driven to implode by a radiation field. The fuel mixture inside the capsule is compressed in a short time (tens of nanoseconds) to very high densities and temperatures until it ignites. Ignition is the point at which energetic fusion fragments, also called reaction products, heat the fuel which generates additional fusion reactions faster than the fuel can expand and cool. In this way, a burning wave can propagate through the fuel.

For both of these the physics is difficult. Incredible progress has been made in both methodologies but each has a long way to go and both methods are quite risky. The completion of a next-step machine for MFE or IFE may show the real capabilities of either method. Either method, MFE or IFE, could potentially result in a power reactor.

One reason to care about fusion power is that fusion power has the potential

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to provide energy without creating greenhouse gases and smog. In addition, as compared to nuclear fission plants, fusion reactors have the potential for much less radioactivity and improved safety. The reduced radioactivity is because there will be no fission products or heavy metals such as uranium. The reasons for the improved safety are that there will be much less decay heat after shutdown, there is no possibility of a runaway "chain reaction" leading to meltdown, and there is no nuclear proliferation threat.

Sounds wonderful, doesn't it? The problem is that it is hard to do.

What is a z-pinch? Could pinches meet the requirements?

A z-pinch is a plasma created by an axially flowing current; this means current flowing in one direction at a given distance from the axis. The current flowing along a straight line creates a magnetic field. The magnetic field acts in such a way that an electron moving in the axial direction feels a force pushing toward the axis. This inward force by the self-induced magnetic field is what "pinches" the plasma toward the axis (commonly called the z axis, hence the name).

There are a few ways fusion could be obtained in a pinch. I will only describe the Dynamic Hohlraum configuration. This type of z-pinch inertial fusion target (the term "target" refers to the materials that need to accept the energy from the power-carrying transmission lines, in this case the wires and everything inside them) is shown schematically in Fig. 2. The parameters I list are those of the Z machine at Sandia National Laboratories in Albuquerque, New Mexico, the world's largest z-pinch driver today. (Please check out the web site http://www.sandia.gov/ACG/articles/pinch-me.htm, which contains a movie about the z-pinch program and an animation showing how the chamber might be filled.) Of the nominally 10 megajoules (MJ) of stored electrical energy in its capacitor banks, roughly 2 MJs of x-rays can be created. (These x-rays, or high energy photons, are an artifact of the very high temperature material, just as light is an artifact of the temperature of the Sun.) The machine can carry more than 20 mega-amperes (MA) of current at more then 5 megavolts.

What you have in a Dynamic Hohlraum (Fig. 2), is a cylindrical wire array (hundreds of ~7-micron tungsten wires) inside which is a small cylinder of low-density (~14 mg/cc) foam (CH). By passing current (>20 MA) through the wire array, a radially-directed force moves the wires inward or towards the axis. The wires heat as the current flows through them and become a plasma sheath (a fairly uniform "curtain" of tungsten). The arrow in the picture illustrates the path of the electrons through the wires. The wires in the target strike the inner foam and create a hohlraum, which means cavity or hollow (though for most of the physics community, hohlraum is defined as a "radiation case" or radiation-confining oven). This is a radiation-confining cavity or hohlraum because the tungsten absorbs and re-emits low-energy x-rays back into the confined volume—hence it acts like an oven wall. These x rays are created when the tungsten strikes the low-Z foam (Z here means atomic number). The process of slowing down during the strike converts the kinetic energy of the fast tungsten into high-intensity x-rays. Because the tungsten plasma sheath is moving, this configuration is called a Dynamic Hohlraum.

When the inward-moving plasma sheath strikes the foam, it generates both a radiation wave and a pressure wave. Together they move to the axis, with the radiation moving faster than the shock. This radiation pushes on a capsule containing fusion fuel in the center of the imploding plasma/foam

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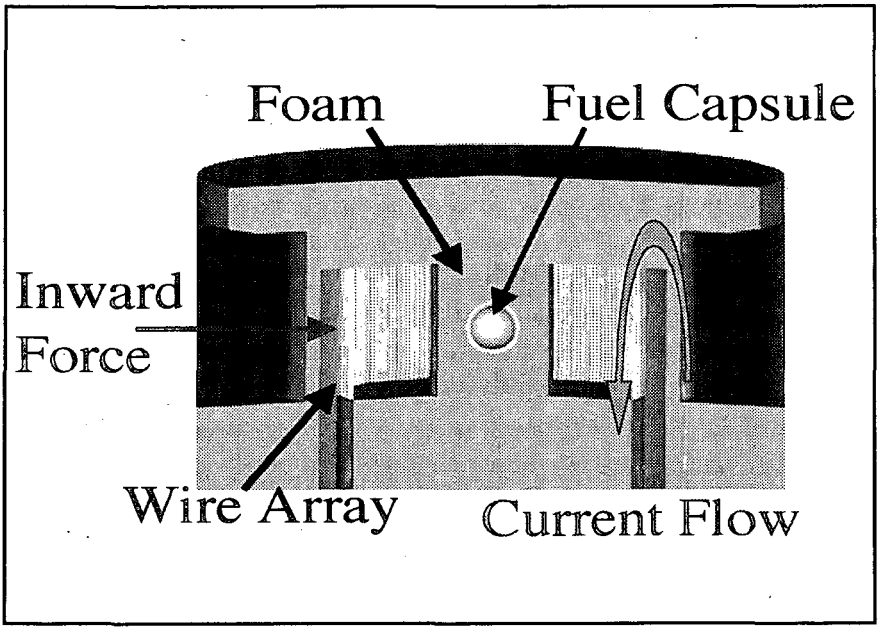

structure. If the pressure on the fuel capsule has the appropriate characteristics, then the fuel will burn and a net energy release will be obtained.

This type of target is promising in IFE because it is of roughly the right size, and heated to the right temperature to adequately heat the deuterium-tritium fuel inside a fusion capsule. There are some important characteristics such as the time history and the spatial uniformity of the radiation field that need to be obtained before ignition and high energy yield will be obtained in this type of pinch.

I'll next examine some significant engineering (not physics) differences of magnetic fusion energy (MFE) reactors and two Inertial Confinement Fusion (ICF or IFE) concepts (laser-driven and z-pinch-driven. (Disclaimer: what follows is my opinion—it is not to be taken as Sandia's public stance or the opinion of anyone else.)

Let us assume that the appropriate physics conditions can be created in the target. The question then becomes: what is needed for a reactor?

Fusion power plants, MFE or IFE, will have a great deal in common. Land, electrical turbines, waste-heat disposal, and tritium handling (an environmental and safety hazard) will be required in each case. Fuel will need to be handled and processed. Radioactive waste will be generated and need to be stored even though typical radioactivities, half-lives and volume of waste will potentially be vastly reduced from those of fission power plants. These issues will contribute significantly to the cost of any fusion plant.

The fusion reactor components of these power plants also have some things in common. I have illustrated these schematically in Fig. 3. Each concept has a central plasma surrounded by a vacuum. There is a coolant which moderates (interacts with and slows

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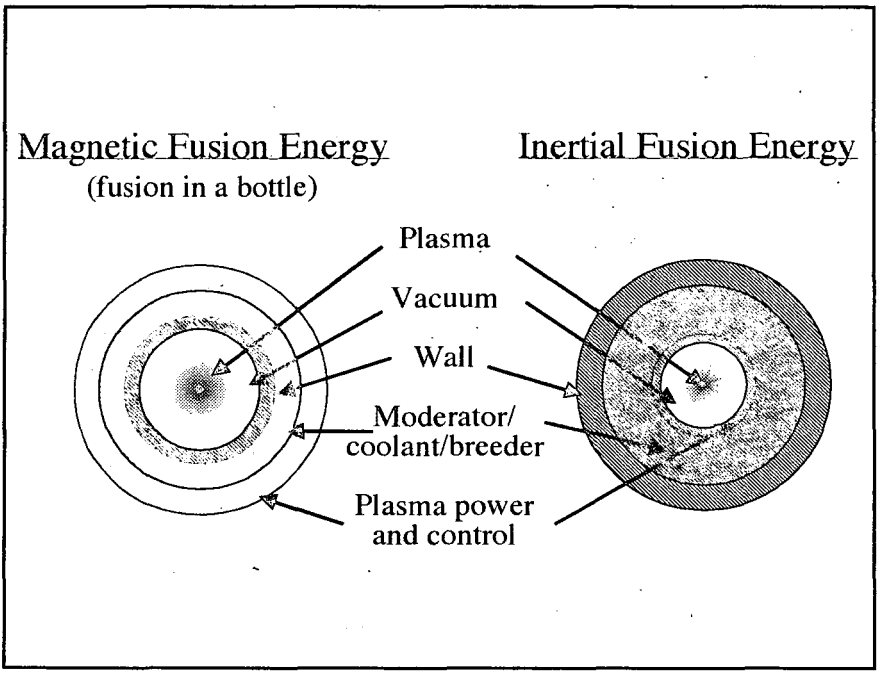

down) the fusion neutrons; it is used to breed tritium and usually acts as the "working fluid" to pull heat (the thermal reaction product) out of the reactor to feed it into the electricity-generating part of the system. These reactors all have a driver (i.e. the equipment to create the fusing plasma).

The differences are legion. Let's work out from the center. The MFE plasma can be many cubic meters in volume and it needs to last a long time (milliseconds to steady-state). The ICF plasma is small, less than a cubic centimeter, and it only lasts a few nanoseconds. The MFE plasma requires excellent vacuum, meaning particle pressures less than 10^{-10} torr (760 torr=1 atm). This is a technical challenge in its own right. The pressure requirements are much less extreme for ICF reactors (~10^{-6} torr). In an MFE device the wall has many apertures to allow for heating and fueling the plasma. This wall must also survive the full neutron flux produced by the fusion reaction products and developing this wall is what I consider the hardest problem to solve for an MFE reactor. This poor wall must withstand enormous power densities and neutron irradiation without outgassing (evaporating material) significantly into the chamber. It must also survive for a long time.

In addition, MFE machines require lots of complicated high-power equipment to maintain the plasma conditions. Keeping these mechanisms working reliably will be quite difficult. Because of the bulky plumbing (for power supplies to heat the plasma, fueling, field coils and moderator/coolant) it will be difficult to obtain adequate tritium breeding.

This wall may also be the saving grace of an ICF reactor. If you look in Fig. 3, the moderator sits inside the wall of an ICF design. The moderator in ICF reactor concepts absorbs much of the neutron energy. This material is normally a liquid and weakening of the structure is not an issue as it is for MFE. Recently at

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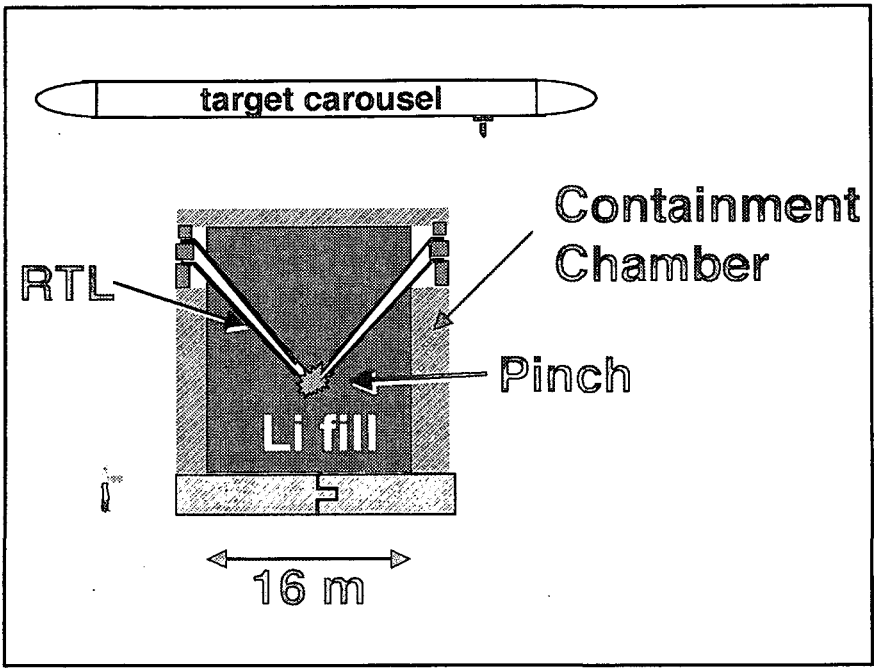

the Fusion Summer Study in Snowmass Colorado, my colleagues and I showed that the wall lifetime due to neutron damage may be long compared to the reactor lifetime of nominally 30 years for a z-pinch-driven power plant.

In our concept of a z-pinch-driven reactor, the moderator absorbs the shock of the explosion as well as breeding the tritium. The neutrons are substantially reduced in energy by the time they reach the wall so there is comparatively little neutron damage and activation. An important point here is that a low-Z moderator will have little activation compared with a high-Z wall. Our design also means that only the region between the electrodes needs to be pumped to 10^{-6} torr and the bulk of the chamber may need to be pumped down to only a few torr. This is a big deal, because pumping large volumes fast is hard to do.

In Fig. 4, we have a simple sketch of a z-pinch-driven reactor chamber. There is a central containment chamber. At the beginning of a shot, meaning a single energy-producing event or firing of the machine, a crane moves a prepumped target/electrode assembly into place on the machine. After this is loaded into the reactor chamber, the chamber is filled with bubbles of Li or FliBe (a ceramic made of fluorine, lithium, and beryllium) as the moderator and working fluid. The working fluid, inside the chamber wall, is then pushed out of the chamber with a plunger. The fluid goes to heat exchangers while the tritium and other materials will be extracted for the next event. The light gray outer area is a shielding-wall confinement chamber to protect the bulk of the machine components from any radiation not absorbed in the moderator or reactor wall. Power is supplied by a large array of capacitor banks that are not shown.

One of the most dramatic benefits of this arrangement is that the total induced radioactivity may not necessitate

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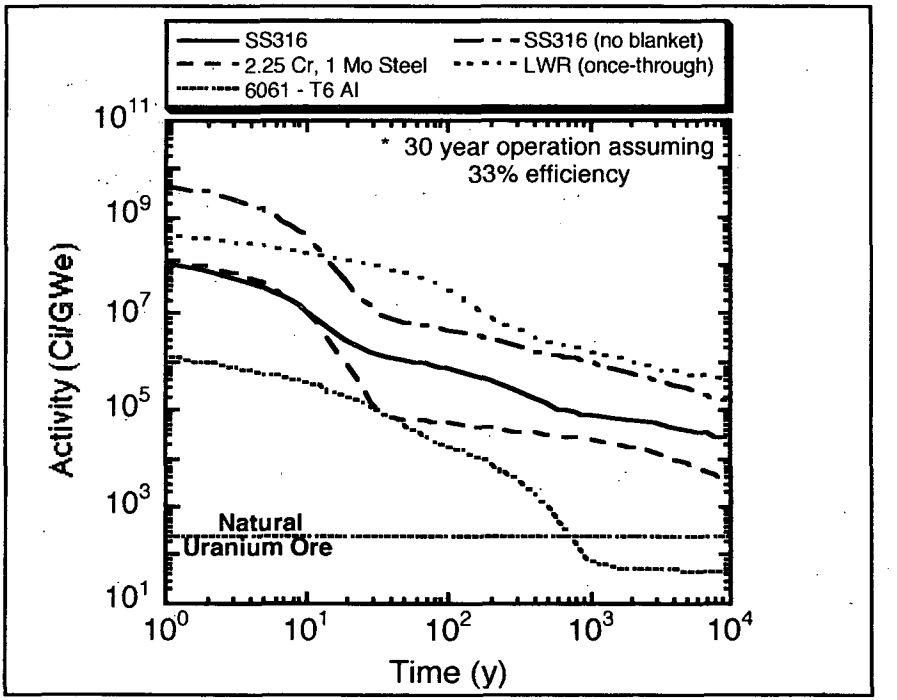

geologic storage. In Fig. 5, we show the results of some calculations illustrating this point. This figure shows the chamber-wall activation as function of time after shutdown following a 30-year plant operation, assuming a 30-GJ fusion yield per target and firing at a 0.1-Hz shot rate for an 80-cm-thick FLiBe moderator/coolant blanket surrounding the target. Chamber wall materials which were studied include stainless steel (SS316 (solid line)), a chrome-molybdenum steel alloy (2.25 Cr -1 Mo) (dashed line), and high-purity, low-activation Aluminum (6061—T6 Al (small dotted)). Also plotted are the activity of a stainless steel (SS316) chamber with no blanket (dot-dashed), and a once-through fission light water reactor (LWR) (large dotted line). These calculations were performed assuming continuous operation with no down time for maintenance. For comparison's sake you can see that under the best conditions it may be possible to have the power-plant-plus-moderator radioactivity below the activity of an amount of uranium ore capable of generating an equivalent amount of electrical power within a thousand years. I can't speak to what the regulatory environment might be by the time fusion is ready for commercialization, but a radioactivity level comparable to uranium ore is easy to relate to and possibly safe enough for society to accept. This result also implies that geologic storage of waste may not be necessary.

There are a number of technologies vying to be the motive power for ICF. These are lasers, ion beams, and now z-pinches. I will only discuss lasers and pinches.

With a laser driver, you fire many laser beams through the vacuum to a target. The chamber will need hundreds of apertures. Flowing liquid metal walls of lithium or FliBe, etc, are proposed as a means of breeding fuel and moderating the neutron flux. The laser optics will

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need to be protected somehow from the debris of the blast, the laser beam must be transported to the target, and the laser system must be capable of firing many shots per second. In addition, there must be a reliable way to rapidly load these targets and align them to tight tolerances so that the lasers can hit them. In addition, pumping out this many cubic-meter chamber 3-5 times per second so that the laser beams can be transported to the target will be a difficult problem.

Today's z-pinch concept uses current supplied through solid electrodes. These are mechanically coupled to the fusion target. This simplifies target insertion and target alignment as compared to the competing ICF drivers. This is because they locate the targets as well as provide the power. The electrodes that transport current to the target are meant to be destroyed and recycled; Steve Slutz (of Sandia National Laboratories) coined the term RTL, or recyclable transmission line. The RTLs may be made of the same material as the moderator. We believe they need only meet presently obtained tolerances.

For our z-pinch concept, we opt for a lower shot rate and higher energy yield per event than other concepts (every few seconds) rather than many times per second. Because the relative cost of the chamber and pulsed power driver is lower than other options, it may be feasible to have many chambers. This would raise the time between shots to tens of seconds in each chamber. From the perspective of having to move tons of material per shot and pumping speed, this simplifies the engineering. Multiple chambers also allow for periodic maintenance and improved overall reliability.

Regarding the per-shot cost of these electrodes, the Advanced Manufacturing Group at Sandia National Laboratories obtained a crude estimate of the RTL cost that leads us to believe the costs may be economically acceptable. The estimate assumes that all handling and manufacturing of these materials must be done robotically and in inert atmosphere. This is true for any hot fusion reactor concept. There is negligible materials cost because the material is recycled and the capital costs were not included.

There is one more big advantage to a z-pinch. The pinch machines are a relatively low technology. Metal, plastic, oil, shock, dust, and debris are all part of the pinch environment and if you are going to build a big, earth-shaking machine and move a lot of material, then this is the way to go. Screen rooms and high vacuum just seem like poor companions to large mass flows and floor-shaking environments.

This whole list of advantages may be enough to one day make a pinch driver reactor feasible. It is my opinion that the advantages described here mean that this program deserves a broad base of support and should be more adequately funded.

There are huge problems that need to be overcome for any potential fusion reactor concept. Neither MFE nor ICF plasma physics has been demonstrated in a laboratory, even though the physics of ICF has been demonstrated in the performance of the H-bomb. At this point, z-pinches have not made thermonuclear neutrons from capsule implosions—a significant milestone. However, the only concept that I believe may be buildable with anything approaching near-term technology is the pinch-driven reactor. In fact, sometimes I could just pinch myself and see if I wake because this technology looks so promising. □

For more information:

Two new references on pinches are "Physics of High-Density Z-pinch Plasmas" by M.A. Lieberman, J. DeGroot, A. Toor, R.B. Spielman, published by Springer-Verlag, December 1998, and "The Physics of Fast Z-pinches" by D.D. Ryutov, M.S. Derzon and M.K. Matzen., in the *Reviews of Modern Physics*, Vol.

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72; No.1, January, 2000. For more information on laser fusion, refer to John Lindl's book *"Inertial Confinement Fusion"*, New York: Springer-Verlag, 1998. Jeremy Chittenden has provided more depth in the physics of the z-pinch target in a recent article in *Physics World*, May 2000, entitled "The Z-pinch Approach to Fusion"; and Gerry Yonas has also discussed z-pinch-driven fusion targets in the August 1998 *Scientific American* article "Fusion and the Z-Pinch".

A version of this article can be found at *http://www.sandia.gov/ACG/articles/pinch-me.htm*. This version links to a movie of the Sandia Z machine and an animation of how the RTLs might work.

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About the Author

Mark S. Derzon started his technical career as an undergraduate working at the Phaedrus machine (an MFE device) at the University of Wisconsin at Madison. He moved on to "play" at the Lawrence Livermore National Laboratory TMX_U (another MFE) machine. Afterwards he did a short post-doc at the NOVA laser facility (IFE). Moving on to Sandia Laboratories, Mark worked on ion beam fusion and then z-pinches. An extraordinary opportunity came Mark's way and now he works for a group at Sandia Labs whose motto is 'A Secure Nation in a Secure World'. Maybe he'll explain that another day, in another article.

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IN TIMES TO COME

Our July/August "double" issue leads off with "Bug Out!," the first collaboration by two young writers with short but impressive track records. Both Michael A. Burstein and Shane Tourtellotte have quickly made themselves very familiar to *Analog*'s readers, and both have been nominated for (and in Burstein's case, won) the John W. Campbell Award for Best New Writer. When they put their heads together, they become, in effect, still another "new writer" with quite a tale to tell. "Bug Out!" throws its characters into a new kind of conflict with a familiar principle of interstellar contact. Sometimes called the "Prime Directive," its basic pronouncement about such contact is: "Don't!" But what if you've been secretly studying the inhabitants of a world from a good hiding place, and suddenly they do something unexpected and exciting and you find yourself in imminent danger of *their* contacting *you?* The law may be clear, but do you regard the situation as problem or opportunity? Humans being humans, you probably can't agree . . . but you can only make one choice. Bob Eggleton introduces the story—and the issue—with a strikingly unusual cover.

Our science fact article is an unusual one for us in several respects: it's long, it's largely biographical, and it's about science that's been around for quite a while instead of what's happening on the current frontiers. But it's told in a unique way (many of you won't even know who you're reading about until you're well into it), and it sheds important light on how science happens, now as well as then. Author Dean McLaughlin (whose own background gives him a unique personal perspective on the subject) calls it "He Who Carried the Moon." Some of you, of course, will guess right away who that is; but even you, I think, will enjoy and learn from Dean's eaasy.

We'll also offer another hefty installment of Ben Bova's novel The Precipice, and an assortment of other fiction ranging from quite serious to seriously silly, by such authors as H.G. Stratmann, F. Gwynplaine MacIntyre, Jayge Carr, and Laurel Winter.

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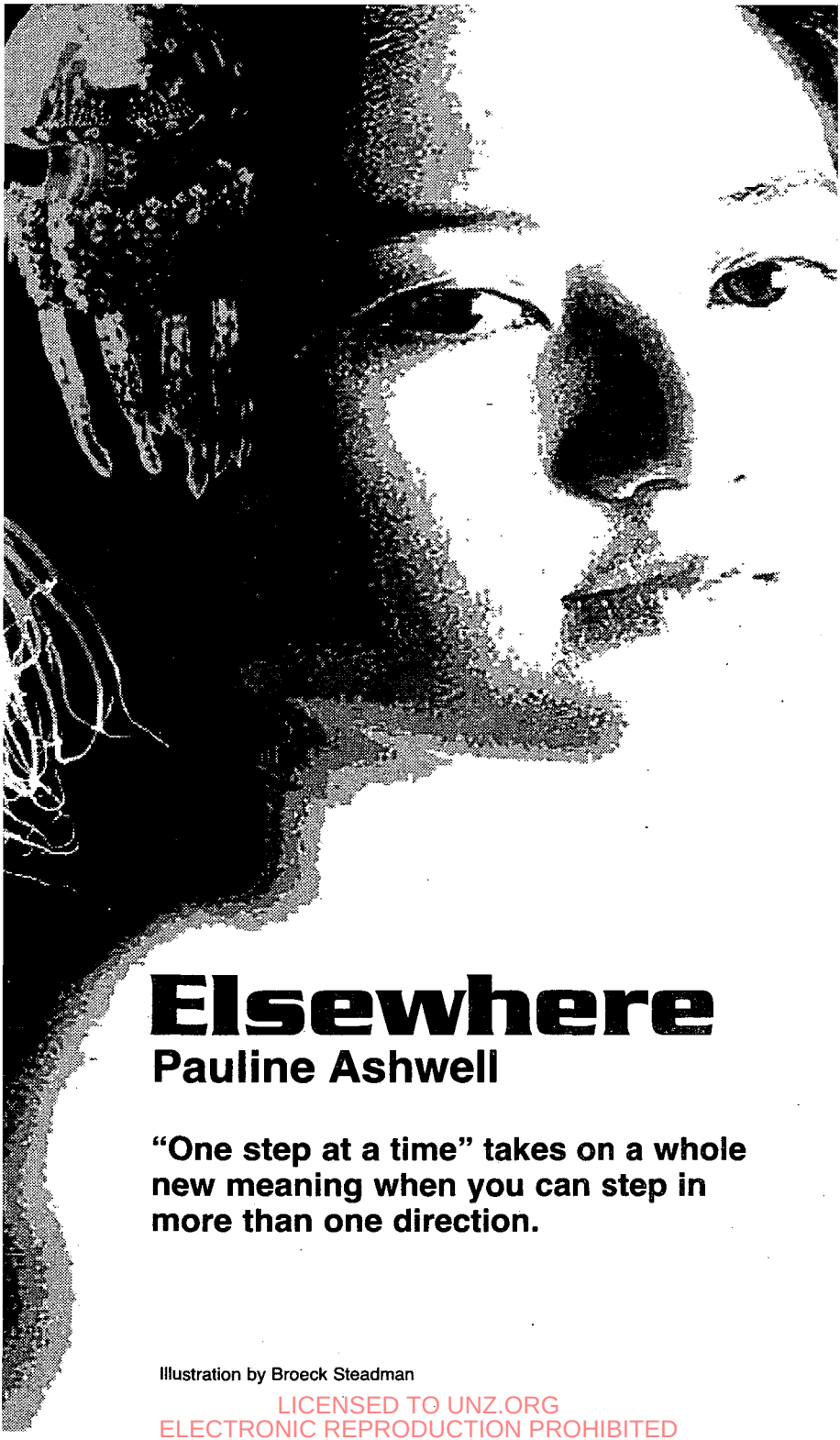

Elsewhere

Pauline Ashwell

"One step at a time" takes on a whole new meaning when you can step in more than one direction.

Illustration by Broeck Steadman

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When the message finally arrived, Haru was seated at a Viewer in the big Zooplankton Lab, working on a census of jellyfish.

At this stage in Downside's terraforming, only six species of jellyfish had been introduced, each belonging to a different family; it had taken her about ten minutes to learn which was which. The whole job had been computerized almost out of existence. The contact plane of the Viewer was set to travel on a random path that took in exactly one-thousandth of Downside's Minor Ocean, to a depth of thirty meters. When the photons impinging on the plane formed one of the patterns recognized by the program it stopped moving and an image appeared on the screen, along with a brief menu, waiting for appropriate entries to be made. Altogether it required, at the most, twenty percent of her attention. Her thoughts ran on steadily underneath.

Three months ago, Haru had been working twelve hours a day, weighing up the numerous variables affecting plankton production in the million square kilometers of ocean controlled by the Central Asian Republic. Now she was free to work just as long or as little as she pleased. It would not matter if she just walked away; on the planetary side, the contact plane was locked to a single instant of time, and if she came back an hour or a week later, the census would continue from the point where it left off. If she never came back, somebody else would finish the job.

When it was explained to her that *nobody* was in charge of the lab, everybody working there was equal in status and could decide for themselves what work to do, Haru had taken it to be formspeak; a long time ago somebody in authority had decided that that was how things ought to be, and everybody was forced to pretend that it was actually so. Taken seriously, it was obviously a prescription for chaos. Unpopular jobs would simply never get done. But in when sample collections of plank from various place-times arrived, body who was not working simply one; they all got classified and cou and none was ever left at the end o day.

It was the job all marine biolo were put to do when they first arr in Elsewhere; a simple routine to k them occupied while they learned t way around. None of them seeme object. Haru had the impression every one of them thought that t were unbelievably lucky just to be h Not only because it meant an esc from whatever danger or frustration left them ripe for a Recruiter, but cause of the project itself. To take pa the terraforming of a barren planet, thousands or millions of years in w to accomplish the job; if it had n been their ambition that was only cause it had never occurred to them it could be possible.

If they knew how she felt right r they would think Haru incredibly grateful. She wasn't. She knew wh debt she owed to the Recruiter. Ev she *was* now stuck on jobs she c have done (in some cases *had* d quite efficiently when she was ten y old.

Until three months ago Haru hac longed, in every sense of the wor the Institute of Useful Sciences in Eastern Asiatic Republic, having b among the one-in-ten-thousand *no* children picked for training there. T good fortune was pointed out to a them at regular intervals. None of t went hungry for so much as a day. I in the depths of winter they were n really cold. Their work did not inv heavy labor, their life expectancy w most twice that of other *nomins* an course, they had the honor of ser the Republic rather than the selfish of their own families.

Up to the end of their ninth year

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were given a general education by some of the best teachers in the Republic. Haru, blessed with a quick mind and a first-class memory, enjoyed every minute of it. Then in their tenth year they were apportioned among the various sciences and given appropriate training. Haru and nineteen of her schoolmates were allotted to the Marine Productivity Section of the Department of Food.

Haru loved marine biology. The weird shapes and life-cycles of marine creatures fascinated her, but best of all were the lessons on the great cycles through which the elements essential for life—oxygen, carbon, nitrogen, phosphorus, sulfur, potassium—circulated. Those made her feel she was taking part in the processes that kept the world going. Certainly she had been lucky in that; even luckier to have been chosen at the end of that year to be trained personally by Professor Oe. By the time she was eighteen she had become his principal assistant.

Of course, it might be considered even greater luck that now, four years later, she was still alive.

She finished clicking off the final datum on the last jellyfish in this particular swarm. The screen went blank as the contact plane whipped off on the next leg of its journey. Haru became aware of conversations in progress, as people who had finished with one sample waited for the next batch. As usual, they were criticizing aspects of The Plan, which set out the order in which introductions were to be made so as to keep a viable ecology going at all stages.

Later stages of the Plan were purely tentative, but the first thousand-year period (planet time) was meant to be firm unless some aspect of it proved not to be working. Not that the people who had set it up were supposed to be any more important than the most recent newcomer; they just happened to get in first; but Haru was still startled whenever she heard somebody criticizing their policies.

In Elsewhere, anybody was entitled to express opinions; she had dismissed that as formspeak, once. She had even observed evidence that seemed to suggest she was right.

When she first arrived in Elsewhere, the enormous variability of the population kept Haru in a state of culture shock. Owing to the Republic's Ethnic Rationalization Program she had grown up thinking that human beings had straight dark hair, dark eyes, and cream-colored skin. The only important variation was in size. Admin were tall and slender, Security tall and broad; and *nomin* were small (a thoughtful provision which undoubtedly increased their chances of survival when food supplies ran low).

She knew theoretically that the human race included other types, but she had not been prepared to encounter people as dark as their own shadows, except for the gleam of teeth and eyes; or with hair so fair it seemed translucent and eyes like sky seen through holes; and just about every shade of pigmentation between. Then there were people with long hair, short hair, straight, wavy, curly, strained into extraordinary shapes and patterns; no hair at all. And those as small as herself, beside giants over six feet high.

Even so, when she was introduced to the Zooplankton Lab, the man called Bryan was a new experience; he had hair all over his face, a curly tangle that concealed everything but his nose. It took her a little time to realize that much of the hair came from a beard. The only bearded person she knew was Professor Oe, and his had been a neat little gray triangle on the end of his chin; whereas Bryan's concealed even his mouth, except when he talked, which he was doing when she saw him first.

His theme was that the Plan had been devised by bleeding-heart types who decided that this nice new planet should become a haven for *all* Earthly life-forms

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(except for a few they found repugnant, such as rats and poison ivy and skuas and vampire bats—oh, and fleas and lice and flukes and tapeworms and biting flies), including those that had become extinct through the actions of Man. They had not the slightest idea of the work involved in establishing even *one* species in a strange habitat without bringing in whatever parasites normally infested it; or the kind of problems that would arise over trying to establish migrant birds in a world whose pattern of continents was completely different from Earth's; or how much work would go to waste when the climate shifted during one of the million-year jumps that were part of the Plan, or—

At that point a new lot of samples came in and he not only lost his audience but grabbed one and began work. Haru had listened in astonishment and alarm. Surely the Planners, whoever they were, would get to know of this—this dissension, and the reckless critic would suffer for it. And, in fact, a week or so later, Bryan was no longer there.

It seemed to Haru that her skepticism over Elsewhere's liberalism had been justified. Then, a month after he had vanished, Bryan reappeared.

She did not recognize him. His hair was cut down to a stubble and his face bare and darkly tanned. Then one of the women jumped to her feet, shouting his name; and in seconds half the people in the lab were round him, demanding to know what had happened, where he had been, how he was getting on.

Bryan raised a large, scarred hand. "Hey, hey, calm down. I've been on Earth, of course—don't any of you read the *Projects* files? Mine's up and running. I've just come to the end of the preliminary research, and can do with some help on the practical side."

A kind of embarrassment prevented Haru from joining the group round him. She gradually pieced together the story from comments overheard, then and later. Bryan had been away from Elsewhere for a month, but he had spent eight and a half *years* on Earth. (Theoretically Haru understood about the three time-streams involved—Terran time, Elsewhere time, and Lifetime (there was also Planet time, which applied to operations on Downside) but it still took her aback when they impinged on her personal experience.)

He had been studying a type of animal Haru had never heard of, known as a sea-cow. There were three kinds—manatee, dugong, and Steller's. (Two had become extinct a couple of centuries before she was born, and the other a good deal earlier than that.) They were all large, peaceful mammals, living in rivers or on the sea-coast; and all vegetarian. If Bryan's project succeeded they would become the first mammals to be settled on Downside.

A young man—a more recent arrival even than Haru herself—came out with a question she would have asked as soon as she had found the nerve: "How did you get to do this? Who authorized it? *I* want to bring sea-birds in. How do I set about it?"

Bryan hooked a stool from a nearby bench and sat, rather heavily.

"OK. Lecture coming up. 'S true enough noone gives orders. You're free to do what you want—if you can arrange it. Thing is, to manage anything worth doing you need cooperation. If your plan's worth following, people who've got the expertise and the time to spare will volunteer to come in on it. If they suspect it's going to be a waste of lifetime, they won't. Don't forget, they're free too.

"How you start, you work out your scheme and put it on the computer net, under Projects, Biological. You state what you want to do, why you think it'd work at this precise stage in the Plan, what you need to bring it off. Don't forget about Time. You're bound to need Gates to places on Earth, as well as to Downside. Find out where they've been established already and make your plans

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to fit. I found there was one at about 8000 years BC, far enough back so that there weren't many humans around in the places where I wanted to go—it had been set up for prospectors, so there were backup services in case I got into trouble. That's important too.

"Once your project's on the net, people will send in comments—problems you haven't mentioned, ways it may interfere with something that's already in hand, reasons it'd go better after the next thousand-year jump. Well, bringing in sea-cows isn't going to interfere with anyone's plans. They're strictly vegetarian, so they won't deplete stocks of fish or even plankton. Seagrass has been established already in a dozen places round the Minor Ocean and being cropped will encourage new growth. I managed to convince enough people that my Project was not going to be a waste of lifetime and resources. That's basically what you have to do."

Part of Haru's mind was taking this in and storing it for future reference. The other more conscious part was considering this further evidence that the account she had been given about Elsewhere's organization, or lack of it, appeared to be actually true.

The Institute was a hierarchy, and it had never occurred to her that society could be arranged otherwise. There was the Director, and the Deputy Directors under him but above the Heads of Sections, through whom orders came down to the *nomin*; even among them some oversaw the actions of others.

The agents of Security were a bit off to one side. It was all so ingrained in her mind that she had hardly ever thought about it; certainly not about Security, who dealt only with people who did not obey.

That was what she had assumed, until the moment, well before dawn, when she woke to find a woman from Security leaning over her, with a man in the same uniform standing by. They took her to a basement room, strapped her down on a bench and injected something into her arm. Then she was lying in her own room, with a sore throat and a mouth as dry as desert wind, and it was afternoon. She could remember nothing in between except a dispassionate voice saying, "Tell me about Professor Oe."

What could she possibly have told them that was not common knowledge? Despite being a member of the Admin class he was courteous to all his subordinates, even the *nomin* among them; he never made sexual demands on them, although according to the gossip, his wife was dead; he knew everything there was to know about factors affecting the productivity of the sea and was determined to pass on his knowledge to as many as were capable of absorbing it.

Three days ago, when she saw him last, he had seemed preoccupied, but she had no idea why. As for his daily comings and goings, Security must know a great deal more about them than Haru did. There were monitors everywhere. Unless there was some kind of disturbance, most of the records were wiped without inspection: but not those from the areas occupied by people of importance. Professor Oe had warned her, indirectly, to be careful what she said in his company; when—rarely—he was moved to criticize Admin policy, he had his own version of formspeak.

Could someone in Security have been bright enough to decode those comments? Or could *she*, drugged, have explained them? Could a man like the Professor, valuable enough to have been made Head of a major section of the Institute, be in trouble over a few sharp remarks?

In the morning, Haru summoned up the courage to go in search of the Professor, but he was not in his office or in any of the labs. That afternoon an order from the Deputy Director in charge of Food Production came to each of the trainees. They had all been responsible

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under the Professor's supervision for some part of the regular three-monthly report; now they were instructed to proceed with that work in his absence. Haru, who had helped the Professor to put the whole thing together in the previous year, was put in charge.

It seemed unlikely that she would ever see Professor Oe again.

The finished report was not going to make the Deputy Director happy. Harvesting would have to be cut by at least four percent if the decline was not to get worse. The present Director was on the verge of retiring and every Deputy was hoping to replace him; it was quite irrational that the D.D.'s chances should be affected by uncontrollable changes in weather patterns and ocean currents, but then status in the administration had little to do with actual competence and everything to do with results. Or so Professor Oe had hinted. (Could she have told Security that?) In any case, Haru's duty was simply to write the report; the consequences were not her affair.

Three days after handing it in she was summoned to the office of the D.D.'s personal secretary and directed to a seat in front of the desk. This was bare except for a voice recorder and a sheet of paper. Reading the heading upside down, she recognized the summary of her report.

The secretary indicated it. "Voice that into the machine."

Haru picked it up and began to read. "As acting Head of the Marine Productivity section I have the honor to report as follows: Overall productivity of plankton has increased to the point where harvesting of this resource can be increased by six percent over the next period. This is due in part—"

She lowered the sheet. "This is not what I wrote!"

"You will voice it to the recorder. Now."

There was a faint rattling sound. The paper was shaking in her hand.

"Control yourself," said the secretary sharply. "Take deep breaths. Then read."

If plankton harvesting was increased now, there would probably be a catastrophic drop in productivity over the next half-year. Professor Oe would never have agreed to it. Was that why he had disappeared?

She tried to speak. It came out as a croak. The secretary rose impatiently and poured her a glass of water. Haru sipped it and tried to think.

Did the D.D. think his chances of becoming Director were good enough for him to risk issuing a faked report—especially if there was a handy subordinate to be blamed for it when the inevitable catastrophe came to light in six months' time? And what would happen to the subordinate then?

Professor Oe would never have voiced that report. Never.

She was not Professor Oe.

She could not be sure that voicing the report would win her even a short respite. The D.D. might think it safest for her to have an accident almost at once; or perhaps for her to commit suicide—a regrettable event explained when the effects of overharvesting the plankton became obvious in a few months' time. But refusing would bring retribution immediately.

Haru picked up the paper and opened her dry lips.

Nothing came out. She cleared her throat and tried again.

"I—I—hrr—I—"

The secretary made an impatient sound and switched off the recorder. "I have no time to waste," she said. "I will gave you half an hour to recover your wits."

Hands closed around Haru's wrists. She was hoisted out of the chair and turned towards the door. Women in Security uniforms were on either side of her. For a couple of steps she was more or less carried; then she regained control of her legs and walked stiffly out into the maze of passages that led to the

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nomin living quarters, and at last into her own room. They let go of her wrists and shut the door behind them.

For some moments Haru stayed where she was, seized by a kind of paralysis. Finally she shook it off sufficiently to stumble over to the bed and sit down.

A room of her own, rather than a cot in a long dormitory, had been one of the privileges of working directly with Professor Oe. The room stood for both comfort and status. She would have possession of it for the next half hour, or a little less. After that...

Rousing herself from her stupor, Haru tried to consider the possibility of escape. The sprawling maze of interconnected buildings that made up the Institute included several derelict sections. They were walled or boarded off, but there were gaps. She might be able to get water from the communal bathrooms; but what about food? The supply rooms were kept locked; leftovers, if any, were taken home by the kitchen staff. Besides, Security might not bother with the monitors as a rule, but with a runaway to catch they would certainly check those covering the corridors near the derelict sections.

The only hope was to knuckle under, do what she was told and hope for a sudden spontaneous upturn in plankton production, of the sort that happened once or twice in a century—

Something had gotten into the closet. She could hear scratching. Well, if rats nested in her few garments, it was not likely to matter—not to her.

According to rumor, it was not unlikely that one of the Deputy Director's rivals would poison him; but it was too much to hope that they might choose to do it today...

The scratching noise got louder. That was one thing she didn't have to put up with. Haru rose angrily and pulled open the closet door.

Between her spare working clothes and the tunic she had been issued for public celebrations, a young woman was standing. For a hallucinatory moment Haru thought she was looking at her own reflection. Then her hands were gripped strongly and she was pulled into the closet.

Haru stumbled towards a collision with the plywood backing, met nothing, tripped, and landed sprawling on a floor.

"I'm sorry. I'm sorry. You aren't hurt, are you? Let me help you up. Sit down. Here, drink this."

Without knowing how it happened, Haru found herself sitting on a padded chair, in a room that certainly did not belong on the far side of her bedroom wall. The woman whom she had seen in the closet was bending over her with a beaker of something that fizzed.

The room was about the same size as the one she had left. The walls, where visible, were painted a pale green; but for the most part they were obscured behind racks of monitor screens and other technological items. The floor was a darker green and—she realized now—resilient rather than hard.

Haru shrank back in the chair. The woman sighed.

"Think I'm going to poison you? I can't blame you, I suppose. Oh, well, I can do with a tranquilizer myself." She drank half the contents of the beaker and proffered it again.

Haru's voice and throat were still painfully dry. She accepted the beaker and sipped. It tasted of some kind of fruit. She drank the rest. The woman took the beaker and filled it again.

"My name is Lio," she said. "I've been hanging around the Institute for what feels like months, trying to find a workable disguise. It really is the damnedest place to infiltrate. Whoever I tried to talk to, I got spotted at once as somebody who didn't belong where we were and was probably up to no good. In the end, I holed up in one of the boarded-off sections and recorded everything I

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could access. The items that looked interesting were mostly in a kind of jargon—I think you call it formspeak—that confused my computer no end. I was all ready to pull out when it flagged something for my attention that turned out to be your interview with some bigwig's secretary, and I got the impression you were in real trouble and maybe danger—was I right?"

Haru swallowed, hard.

"Trouble," she said. "Yes."

"At least I got that right. I thought she was threatening you, but it might have been with a slap on the wrist or it might have been execution, for all I could tell. So I thought I'd better get you away. All wrong, procedure-wise—you've had no preparation at all, you don't know anything about me. All I know about you is that you're a marine biologist, but that's really all I need to know. The place I come from—the place where you are now, in fact—needs marine biologists. That's why I was hanging around the Institute. What I have to offer you is escape—and a chance to work on a really major project in your own subject—and a way of life that's a damn sight more comfortable than what you've had so far.

"The main disadvantage is it'll be strange to you. People and customs and surrounding and circumstances will be nothing like you've lived with so far. Properly, you should have been told all about it, as much as *can* be told—nobody can grasp it all just from telling—and asked whether you were interested, before being brought through a Gate; but I thought I had to get in before maybe that secretary sent someone to torture you. Look, if it wasn't as bad as I thought, and you don't want to take a chance on coming with me, I can put you in that room a split second after I got you away. I'm what I suppose you'd call a time traveller. This place we're in now is called Elsewhere, because its time and space are quite separate from those you grew up in. That makes a lot of things possible that you won't be used to, but you'll learn—if you stay here. What do you say?"

The one thing Haru was sure of was that she did not want to go back.

Whatever this woman—Lio—intended for her could not be worse than to stay in the Institute under the displeasure of the Deputy Director, waiting to be blamed for a cut in *nomin* rations and the riots that would follow.

She said, "I will stay."

Haru did indeed find Elsewhere strange, sometimes unbelievably so. The first three days she spent there might have been the strangest of all, but she spent them in a deep, dreamless sleep. When she woke up she was free of a long-standing itch between her toes; a hole in one tooth had shrunk and within a week disappeared. She could understand a language she had never heard before—it was called Standard—and with a little practice speak it fairly fluently.

What startled her most was the shocking prodigality of the lifestyle. She was taken to an apartment that would have housed fifty of the Institute's people, and expected to live in it alone. The furnishings included such items as a video screen, computer, music-player and personal communicator. Food was supplied in various refectories. The portions were indecently huge—enough to have fed a *nomin* family for the whole day. Clothes at least were not too unfamiliar in form—tunic and loose trousers—but she had been issued with half a dozen sets at once and the underwear was so soft and fine it felt like being naked.

Altogether it was a relief, at first, to find the work she was given completely familiar—sorting and counting samples of plankton. Some of the other adjuncts were a surprise; for instance, the samples simply appeared periodically on a bench at the end of the room. Every bench-space was supplied with a computer and each sample was accompanied by a small disc. Inserted in the com-

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puter, this gave the place-time from which it had been collected. The robot samplers were operating simultaneously (viewed from Elsewhere's time-line) fifty, two hundred and five hundred (planetary) years after the date at which the introduction of animal plankton had begun.

For the first couple of weeks Haru stayed interested, even though about half the samples consisted of copepods (the miniature crustaceans which formed the base of all plankton food-chains), which she had counted interminably in the year she turned ten. Results were added automatically to computerized charts displayed around the walls. From these it seemed that the carefully chosen introductions added up to a simplified but viable ecology. Once this was clear, Haru no longer found the work satisfying. It helped when the census of jellyfish (introduced at the four-hundred-year point) started, but that was too easy to hold her interest after the first few days.

Furthermore, she discovered that while she knew probably more than anyone else in the lab about the factors affecting plankton, in many directions she was woefully ignorant. She knew comparatively little about terrestrial life-forms, even those that had survived into the 25th Century; or even the biology of marine animals, other than those which constituted the plankton or preyed on it.

It was new to Haru to be behind her fellow-workers in anything at all. The remedy came to light by chance, when she decided to do something about the intimidating vastness of her apartment, and applied for some screens. They arrived, to her astonishment, almost at once, convoyed by a couple of large, friendly young men, who erected them as she directed, asked what else they could do for her, and moved a low padded bench into the enclosure thus formed. This faced the computer, and also the television. An incautious remark made it clear that she did not use the latter, whereupon one of the young men undertook to point out how much information, as well as entertainment, could be obtained from it.

The classification "Natural History", which Haru had noted but not understood, turned out to refer to the lives of animals and plants. From that time on, whenever Haru was not working or at exercise (missing it even once led to an immediate visit from a Health Monitor) she watched videos of animals and plants, of which the Library seemed to have an unending supply. The program which translated the original language into Standard was sometimes clumsy; but Haru learned about the lives of seals and penguins and octopuses and whales, and the march of lobsters over the sea-floor to their breeding ground, and the extraordinary life-history of the eel. She learned about Australian marsupials and Madagascan lemurs and the great apes that were humanity's nearest relatives; many in each group reduced to a few specimens in zoos, or totally extinct, before she was born. According to The Plan, all these creatures would one day live on Downside—but not for some (planetary) millennia. Apart from a few lichens and mosses, nothing lived on the drier parts of Downside, as yet.

More and more Haru wanted to escape from routine drudgery in the Zooplankton lab. Then Bryan's little speech showed her how to set about it. She had to find one or more species which could be introduced without interfering with the steady progression of the Plan, so that she could propose a Project of her own.

It was not easy. There were already two groups making a start on the introduction of animals to the sea shores; and at least three on Earth, testing out ideas on how to start coral reefs from scratch. Haru had no experience to offer in either field.

According to the Plan, animals living on the sea floor were not to be intro-

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duced for at least a couple of millennia (planetary time). With half a percent of CO_2 still in the atmosphere, the more organic carbon that fell and got buried in the silt, the better; it might, or might not, get turned to oil in a few million years, but at least it was out of circulation.

All the same, it was on the sea floor, the deepest part of it, that Haru eventually found her Project.

The title of the video was something about volcanic vents, and Haru would have switched it off, except that she had put the kettle on and it chose that moment to boil. By the time she had made her tea, the first pictures had come on screen. They showed a crooked black mass sticking out of the sea floor, surrounded by a dense crowd of small creatures; which, when the camera focused on one of them, proved to be shrimps of some sort.

Haru settled down to watch; and learned for the first time of the extraordinary communities of animals that lived around springs of superheated, poisonous water in the depths of the sea. Besides the shrimps, there were enormous clams, and an assortment of worms, the most striking being tube-dwellers an inch thick and anything up to ten feet long, forming great entangled clumps; there were also little crabs that scrambled over the surface of the worms and nibbled at the red plumes which stuck out from the tube—unless the worm had cannily withdrawn them at the crab's approach. There were various other animals, less obviously different from the general run, including a couple of species of fish.

The video Haru had been watching just before this one had showed the animals of the abyssal plain; the vast expanse that stretched more or less evenly between continental slopes, except where it was interrupted by submarine ridges or chasms. That area had its own varied and peculiar menagerie, but a density of one animal per square meter was relatively high. Around the hot vents it was thousands of times higher.

These strange oases were kept going not by the water itself, but by the poison it contained. Sea-water filtering through the cracks in the sea floor into the hot rocks below dissolved chemicals, including hydrogen sulfide. This gas, poisonous to most life-forms, was the staff of life to certain bacteria, which got their energy by oxidizing it. Some of these lived in symbiosis with an assortment of other creatures. The giant worms lived entirely on what they derived from bacteria living in their tissues. Some creatures filtered bacteria and other morsels from the water, and yet others preyed on or scavenged after the rest. In fact, hydrogen sulfide was to the food-chain around a volcanic vent what sunlight was to the rest of the world; the base on which all life depended.

Haru had watched the video through three times before she was ready for the next thought; the vent communities were completely independent of the rest of the sea, and vice versa. Introducing them to the depths of its ocean would make even less difference to the rest of Downside's ecology than Bryan's sea-cows.

She was so excited that it was some minutes before the really monumental difficulties in the way of putting this thought into practice occurred to her.

Collecting plankton, or shore-dwelling animals, was easy enough. Containers filled with them were hauled through a gate on Earth into a reception area in Elsewhere and thence through another gate to a quarantine tank on Downside, where they were checked for undesirables; after which they were taken to the point where they were due to be released. But life-forms several thousand feet under the sea were another matter. Could they be scooped up by some sort of robot? Not the adult forms, but their larvae, which must be free-swimming; otherwise the new vents

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which sprang up from time to time would never get colonized. In fact, the submarine expeditions that had originally discovered the vents had found a few larvae of—among others—the giant tube-worms; but had never witnessed the spawning process.

Any robot would have to be specially made to withstand the pressure, and what were the chances of the larvae being brought to Downside in a viable condition?

What she needed was a Gate opening from the neighborhood of an Earthly vent directly to one on Downside. But Gates worked only between universes. Downside and Earth were both in the Main Continuum. She needed two Gates close together and back to back, one opening near an Earth vent and one to Downside; could that be arranged?

Come to that, *were* there any undersea volcanic vents on Downside?

While she had not become an adept, Haru had learned the rudiments of using the computer net. An hour or so later, she had discovered that there almost certainly *were* such vents, and that the position of one vent field was quite probably known. A robot scoop collecting samples of sea-bed, in order to check the rate at which organic carbon was being buried, had come up from one traverse with a hold half full of sulfide minerals, of the kind which formed "chimneys" around vents on Earth. The robot had probably ploughed through one such.

At least, Haru thought, she knew where to look on Downside. And the location of dozens of vent-fields on Earth was on record. She would need a Viewer. The contact plane could slide through solid walls, so water under a pressure of several hundred atmospheres should be no problem; but how about light? Vents were hot. Surely a Viewer could be adapted to use infrared?

Haru wrote out a tentative account of the whole project, with emphasis on the problems. When it was finished, it was three days before she got up the nerve to post it on the web.

After that, it was more than a week before the first answer came in.

She had asked how long it would take to establish the necessary population of bacteria around a vent. The answer, to her astonishment, was that it had almost certainly been done already. During the first phase of terraforming, Downside had been seeded with photosynthetic microbes, and, later, with the bacteria that recycled plant nutrients. Various sulfur-using bacteria had been included. No special steps had been taken to seed the sea floor, but the sulfide deposit from the robot sampler had contained at least two species.

It was seventeen days later that Haru had another response, and it came in an unorthodox way. She switched on the TV in the evening and instead of the video she expected, the message appeared on the screen.

Re: Vent faunas, it began abruptly. *Your project suggests interesting test for new equipment combining Viewing and Gate functions of contact plane. Visit Regina Beausoleil, GM 2553 at 20.15*

Decimus Chan.

P.S. Confidential - Do not discuss with others. D.C.

Haru regarded the screen with puzzled suspicion. This abrupt and strangely-delivered message struck her as something that could well have been sent by a lunatic. She wished, almost for the first time, that there was somebody in Elsewhere to whom she could talk.

Her previous life had given her no experience in making friends. At the Institute the people she knew had mostly been familiar from the beginning. Being by far the brightest—and aware of it—she was not popular. The members of Professor Oe's group had been rivals rather than friends.

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The one person for whom she had formed a real attachment was Professor Oe himself. His disappearance, along with the nagging uncertainty as to whether she had anything to do with it, had set the final seal on her isolation.

She might have consulted Lio, but she had not seen the Recruiter since being shown into the decontamination suite. (With a population drawn from every country on Earth over many centuries, Elsewhere was extremely vulnerable to infectious diseases, and new recruits went through a rigorous process of disinfection. Anyone returning from a stint on Earth in human times had to do the same, or—if it was a short visit—to wear an isolation suit, with breathing apparatus. Lio evidently preferred to avoid that.)

When she woke up from three days of induced sleep, Haru had been introduced to Elsewhere by a woman who, finding a more personal approach unwelcome, had settled for giving her basic information and an invitation to get in touch later if she needed anything more. Now, when it might have been useful, Haru discovered she had forgotten the name.

If she wanted to know whether this equipment had any existence outside Decimus Chan's imagination, she would have to go and see this person, Regina Beausoleil.

Regina Beausoleil, it turned out, was a woman. A very big one, tall enough to loom over Haru. She was also very dark skinned, and the light near the door was dim, so that it was impossible to read her expression. Haru was momentarily dumb, and Regina got in first.

"You'll be Haru. I'm an electronics tech, working with Decimus Chan—he said he'd gotten in touch with you. Come in."

GM 2553, it turned out, was a workshop. It was long and wide and full of an ordered clutter of equipment and materials. A single very bright light cast a circle of brilliance; the rest was dim. Regina indicated a stool.

"Take the weight off your feet—not that you've got much. You're the one wants to bring vent worms and such like to Downside, right? Real interesting lifeforms. I hope you bring it off."

Haru was startled. What was an electronics tech doing, knowing anything about marine biology? Techs were there to supply scientists with the equipment they needed, not to criticize their activities.

She said baldly, "Decimus Chan—he is sane, then?"

"Sure he is."

"Then why did he write his message on my TV?"

In the bright light Regina's expression was easier to see, though still not very informative.

"He did, did he? I wonder how he managed that."

"Normal people send messages by com, or on the net."

"I see what you mean." Regina looked faintly amused, which for a tech talking to a scientist was not right . . . Or did equality apply to them too? "Look, Decimus is as sane as I am. A bit eccentric, maybe. He's a genius; it's allowed. As for putting a message on your TV, there's a reason. Anyone can read the net, and it's not too hard to listen in on someone else's com. He wanted the message to be private, that's all."

"Why? Why should anyone listen?" Was there something about all this that had aroused Security? *Was* there Security in Elsewhere, after all?

Regina sighed. "Like I said, Decimus is a genius. He imagines things in four or five dimensions, and then works them out in three. Some of them are things people want very much. Like this Gate Viewer he's working on. Up to now, nobody's been able to use a contact plane for more than one thing at a time—you can hitch it to a Viewer, or open it up as a Gate, but if you try to use it for both it shuts down altogether. And if you put

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one contact plane close to another, one of them will collapse. Sort of an exclusion principle. The limit's the maximum diameter of the plane. So if you want to move something from one part of the Main Continuum to another, you have to bring it into Elsewhere through one Gate, and then take it out through another."

"That I know," said Haru impatiently.

"Well, Decimus found that if you rig one of the planes so that it's one chronon out of phase with the other—and don't ask me to explain that, it's all quantum stuff—you can put them so close together there's not room even for a hydrogen atom in between. And that means you can use one as a Gate and run a Viewer off the other, so you can see just what's on the other side before you go through. What's even more important for terraforming is that you can drive an animal straight through, or a whole herd of them, and they'll never really be in Elsewhere at all. Just think of trying to get a whale from Earth to Downside in the usual way."

"It would be difficult."

"Yes, well . . . there's people who take whales very seriously. Partly because several species were hunted to extinction and they kind of want to make up for it. If they get to know Decimus has come up with something that could be a way to bring them in, they'd be hounding him for information, wanting to give him good suggestions—mostly things he's thought of and discarded because they won't work. And there's two or three who won't hesitate to eavesdrop on his communicator in what they think is a good cause."

Haru by no means understood all of this. She returned to the aspect that really concerned her. "This Gate Viewer, it really works?"

"Sure it does. I've worked it myself."

"But will it work in the sea? In deep? With infrared?"

"I can show infrared in false color, no problem. The situation is this. Now that he's tested the prototype, Decimus has designed improvements to several parts of it. It'll be ten days before they're ready to fit. Meanwhile, nobody needs the prototype. It will take me three or four days to adapt it, but for the rest of the time, it's yours if you want to take a chance with it."

"Three or four days—that means I would have only six or seven to use it."

"That's right."

"And after it is improved?"

"There's a queue. You'd have to wait your turn."

Haru thought hard. What she really needed was to be able to open the Gate between the vent on Downside, and one of those on Earth; and leave it open for months; if possible for a whole (Earth) year. That way there would be plenty of chances for free-swimming larvae to be carried through it. If she had the use of the gadget only for six days, she would have to run through a series of spot checks, hoping to catch one or more worms in the act of spawning, and open the Gate then. It was chancy.

On the other hand, what did she have to lose?

She said, "Thank you. I will accept."

It was arranged that Regina Beausoleil should inform Haru as soon as the Gate Viewer was ready for use, and that Haru should not, repeat *not*, call to inquire. By the morning of the fifth day, she was on tenterhooks. By the sixth, she was convinced of failure.

On the seventh afternoon a message appeared on the Viewer screen:

Come to GM 2553. R.B.

Automatically she checked the time. 16.32.27 73.287. Clocks here had no dials; hours, minutes and seconds in the 24 hour day appeared at eye-level on every wall, along with the number of days elapsed in the present 365-day year and the number of years that had passed since Elsewhere came into existence. For most people it was simply a mild convenience, but those who spent a

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good deal of lifetime somewhere in the Main Continuum, like Bryan, needed the information.

It was all Haru could do to keep from running as she approached the door. This time every light in the workroom had its cone of brilliance under it, and a couple of dozen people working at the various benches. Regina Beausoleil was in a folding chair facing the door, looking half asleep and three-quarters collapsed. She got painfully to her feet and Haru saw that the dark face was overlain by a grayish bloom.

"Good. You were quick," said Regina; and swallowed back a yawn. "This way."

The door was the third along the corridor. Regina pressed her thumb to the lock plate and it swung open. She held out her arm to bar Haru from going in.

"Take a look first." Her voice was hoarse with fatigue. "See where the cables run. If you brush up against anything, you'll lose the picture."

Obediently Haru studied the layout. It was a smallish room, no more than twelve feet square. A monitor screen about three feet high ran the length of the left-hand wall. A long bench two feet in front of the right-hand one was covered with control panels, most of them under plastic shields. The far wall and most of the room's center was occupied with an esoteric mix of gear linked together and to the bench by great swathes of optical cable.

"You'll sit behind that desk," Regina said, "and use the key-pad that's uncovered. Don't for Time's sake touch anything else. I've got half the screen set to show the vent on Downside, and the other half covering one on the East Pacific Rise on Earth. It took me two days to find one at a depth that exactly matched Downside's, and get the contact planes rigged with Earth's just a foot and a half higher than the other, so that when they're both open the current will run the way you want it, and carry the larvae with it, but not so hard they'd be swept away before they can settle. Standard meters aren't designed to be precise on that scale, not when the overall depth is in thousands of feet, and—oh, never mind. It's done."

Haru looked at the screen. It was divided in two by a narrow vertical band. Each half was an expanse of mottled green, brighter in the middle.

She said, "Where are the pictures, then?"

Regina sighed. "There. It's the best I can do."

"But you said it would be in false colors!"

"It is. Infrared shows as black. All right, I know what you mean. I tried it out in full spectrum. Take a look at this." She went quickly to the bench, lifted one of the plastic covers and moved a switch.

The screen sprang to garish life. Each side looked like a section of a rather murky rainbow. In the center was an irregular pillar of violet, bordered at the sides by narrow bands of blue, green, yellow, orange, and red. The red spread outwards, dimming and turning darker, halfway to the edge of the screen.

"No chance of sorting out any details in that lot." Regina switched the screen back to its former green. "I spent half a day trying out different wavelengths, and green gave the best contrast. I'm not claiming it's *good*. Water absorbs infrared. You're seeing mostly by the wavelengths nearest to visible light; they're the ones that attenuate slowest, though more than half have been absorbed a few inches from the source. That mass in the middle of each half-screen is the chimney itself."

"But there's nothing else!"

"Give your eyes time to adjust. The left-hand half comes from Earth. There's a whole mass of tube-worms in front of the chimney. The contact plane's only about an inch from the nearest one. They let just a little more of the infrared through than the water does, so they show just that little bit brighter. I'll run the cursor round the edge and you'll

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see."

A tiny spot of white light appeared on the screen and performed a sort of dance, tracing out a crooked line which persisted for several seconds after the spot had moved on. Once or twice Haru thought she could make out a mass of slightly lighter color beneath the line, but she was never certain.

Regina seemed to understand this. "Right," she said wearily. "Now look at this one." The cursor traced out a small oblong half way up the screen. "That's a worm's plume. Now watch." She manipulated a control. The cursor shot downwards and traced out another outline. "See? It drew back into the tube. I'll show you again." She repeated the maneuver, then switched the cursor off. "Now watch again."

This time Haru was aware of a definite movement; one small part of the indistinct mass had shrunk downwards. She uttered an exclamation.

"Right." Regina was overcome by a tremendous yawn. "You'll see better when you get used to it. I'll have to go; I've been taking Wakeups for two days and the last one's just wearing off." She moved out from behind the bench and indicated that Haru should take her place. "I've left you just three controls. This is the dimmer. I've set it at middle range; push it away from you for brightness, towards you to cut down. This key-pad here is the temporal shift. Its range is just one year—no point in you having more. You won't need second-by-second either. This bottom pair of keys moves the time a minute for every tap. Forward on the right, backwards on the left. The next pair's set for ten-minute intervals; then an hour; then a day. The last pair move the contact plane by four weeks." She yawned again. "You'll have to decide for yourself how you want to work it. And this rocker switch opens the Gate. When you think you've spotted a swarm or whatever of larvae, just press it. The Gate may as well stay open until Decimus is ready for the refit. . . . Stars, I'm asleep on my feet. I'm off."

Haru searched her mind hurriedly for other things she needed to know . . . "The lock!"

"I've set it so you can open it—got your thumbprint from the databank. Good luck."

Left alone, Haru sat down on the stool behind the bench, closed her eyes, rested her elbows in front of the massed controls, and put her head on her hands.

She had assumed that the Viewer would show her something like the pictures in the video. Those had been taken by the light of lamps lowered to the seabed, with the camera in watertight, pressure-proof cases. Of course there was no possibility of pushing a searchlight through a gate against a pressure of 4 or 5 tons per square inch, but she had assumed that infrared light would give an adequate picture. She should have known better. When warm-blooded animals were photographed by night, the infrared came from their own bodies. Here it came from the surroundings. The difference between the worms' bodies and their environment was at the absolute limit of detection. As a result, the picture was simply not good enough to enable her to see if one of the worms was spawning—she could barely make out the worms as a mass, and could not distinguish individuals at all.

Haru had not been taught to consider other peoples' feelings—or, for that matter, her own—but she respected intelligence and hard work, even in a tech. Regina Beausoleil had worked herself to exhaustion; her work should not be simply abandoned even if trying it out meant wasting a little of Haru's lifetime as well.

She sighed, and opened her eyes.

No miracle occurred. The bright and darker patches on the screen did not draw themselves into sharply-outlined forms, but she was beginning to make

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out shapes among them. Haru drew in her breath slowly. It began to seem just barely possible that, if she was very careful and very patient, she might manage to see one of the worms in the act of spawning, after all.

Nobody had ever described the riftworm's spawning, but their anatomy was not designed for internal fertilization. Her main hope all along had been that they would put out their germ cells in sufficient quantities to show up as streams or clouds. There was some chance that, despite the absence of seasons in the abyss, they would tend to spawn at the same time, which would increase the chances of fertilization, and also of the event being on a scale to be easily visible. Whether, if so, she would catch the moment of the event in the three days of lifetime which were all she had available, was going to be partly a question of diligence, but even more one of luck.

But, she realized suddenly, she did not have three days; she had to allow time after the spawning for some of the fertilized eggs to develop into larvae and then to pass through the Gate into Downside's ocean—in fact, she had no more than twenty-four hours at her disposal. Perhaps not even that.

Haru looked once more at the screen—now she could make out the boundaries of the worm-clump quite well. Then she put her finger on the lowest right-hand button of the time-control panel and pressed it five times.

Something moved. In fact, it jumped from almost the bottom of the screen to half-way up the clump of worms. Haru gasped. Then she began to distinguish the now-motionless shape from its background. It had a small rounded center and several legs so thin she could barely make them out; it was, in fact, a very small crab.

At least that showed that the button worked.

She experimented with the one-hour button—the outline of the clump had changed a bit as some worms drew in their plumes and others put them out—then with one day. Apart from the movement of the plumes and of two or three scavenging crabs, there was no difference at all.

The best procedure, Haru decided, was to jump one hour, then shift the time a couple of minutes each way. She got quite good at picking up movements, mostly of crabs and plumes. Once a small fish appeared in the middle of the screen; a couple of minutes either way, and it was gone. Once—just once—there was a cloudiness above the outline of the clump. Holding her breath, she shifted the time to and fro . . . and discovered that some kind of powdery debris was falling from above the top of the screen.

Haru closed her eyes for a minute and went through a breathing exercise said to calm the spirit. Then she opened them and jumped the picture forward yet another hour.

After a couple of hours (lifetime), she stopped to calculate how much of a year she had explored so far. She had put a tick on her notepad for each hour jump; there were fifty-three of them. 2 days, 5 hours.

One hour at a time was too slow. She took to jumping a day at a time; then a day plus one hour, in case the worms, even in an environment where day and night were equally dark, had any tendency to spawn at one particular part of day cycle rather than another.

In the next two hours, she covered fifty-seven days—just under two months. She had now been working four hours with this Viewer, on top of five hours spent counting jellyfish on the one in the lab, and a headache was starting up somewhere behind her eyes. Haru reached for the brightness control and turned it right down.

At the upper left-hand corner of the screen, something appeared. It was oval in shape and about eight inches from

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top to bottom. She saw it only for a moment; she was already turning the light back up, but it was gone.

Her eyes had started to betray her. Time to rest them a little. It was also, she discovered, time to empty her bladder. Her throat could do with moistening, too.

Washrooms in Elsewhere were as different from those at the Institute as everything else. The one fifty yards along the passage supplied not only hot water, clean soft towels and several kinds of soap, but a drinking-fountain of chilled water and a dispenser labeled "Headache Remedy".

To use the dispenser, one stood on the scale at the base and put a hand into a hole. Spray tickled the underside of her wrist and left it slightly wet. Five seconds later, the headache was gone.

Haru was impressed. In the Institute, headaches were endured until they went away.

Drinking from the fountain, she noticed a small plastic container beside it with a couple of tablets in the bottom. Curious, she picked it up. The handwritten label said merely, "Wakeups. R.B." Haru put it back.

Three hours later she had progressed through half a (Terran) year, one day at a time. Her eyes burned and her concentration was going.

She wondered whether Regina's wakeup tablets worked as well and as quickly as the headache remedy. A couple of years (Terran) later, she found her head resting on the edge of the bench. She yawned tremendously and forced her body to sit up.

Regina did not need the tablets right now. When she next needed them, she could get some more. . . . Somehow, Haru found herself back in the washroom. She picked up the little container and forced one of the tablets down her throat. By the time she was back behind the control bench, she had stopped yawning and once her eyes had readjusted, the outline of the worm clump looked sharper than she remembered it.

She jumped forward to the 192nd day of her search.

She had just reached the 200th day when the screen suddenly blazed into an eye-watering brilliance. Haru winced and ducked, her eyes closing automatically. When she opened them—keeping them averted from the screen—the light seemed to be back to normal. She checked the dimmer, but the switch was where it should have been, in the middle of the range. She waited till her eyes had recovered, then continued doggedly with her chosen routine.

A few minutes later the screen changed again, but this time it was the outer regions that glared, while the center was suddenly pitch black. Haru shut her eyes, reached for the dimmer and pulled the switch all the way down.

When she opened her eyes the screen was almost dark, but there was a face in the upper left-hand corner. A man's face, with high cheekbones and almond-shaped eyes and a neat little triangle of beard on the tip of the chin.

Haru gaped at it. The face was perfectly still. Despite the open eyes it looked dead. She felt as though a hand had closed on her throat; fought it off, and screamed at the top of her voice. The face swooped towards her. She pushed herself off the stool and tried to stand—

—And she was lying on a narrow surface, strapped down, with unseen creatures digging their claws into her arms and Professor Oe watching dispassionately above. When she tried to call out to him, the wrong voice said "She's going into convulsions" and—

—She was standing giddily in her own room at the Institute and listening to something inside the closet sharpening its claws; she opened the door and Professor Oe said "Why did you tell them?" and took her hands with dead, cold fingers and dragged her through darkness and tumult and stink—

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—And she was at the bottom of the sea in a narrow thin-walled shell, with the weight of ten thousand feet of water pressing down. She could hear it starting to crack and—

She was adrift in ice-cold blackness, with nothing anywhere to hint at direction. After an immeasurable time, she became aware of a faint current moving her away, and turned to fight against it, trying with all her might to go towards its source. For a long time nothing seemed to be happening, then suddenly she was aware of warmth somewhere ahead. She pushed hard against the cold and darkness and suddenly, although there was no visible light, she knew that she was standing in front of a clump of tube-worms and bathed in the warmth around them. The nearer worms bowed slowly towards her and Professor Oe was looking out at her from the middle of the clump, smiling as she had seen him do only a few times in the whole of her life. She leaned towards him and began to fall. A warm dark river carried her away and she heard his voice behind her, saying "Traumatic reproduction—remember that," and—

Haru woke up.

She was lying on a bed that was not her own, under a ceiling she did not recognize. After a moment she sat up. Things whirled giddily around her for a moment, then stabilized. There were cabinets on either side of the bed; indicators and instruments were recessed into the whole length, which was about half that of the bed itself. She could feel a sore spot under a bandage on her left arm, but nothing was attached to her and various retaining straps hung loose.

A door slid open beyond the foot of the bed and Regina Beausoleil walked in.

"You've come round," she said gruffly. "Good."

She turned and beckoned. After a moment a slight, gray-haired man entered. He stood slightly higher than her shoulder, had Asiatic features and a neat little triangle of beard, and was *not* Professor Oe.

He bowed slightly to Haru and made a brief speech in a tone so low she could not make out a word of it; bowed again, and backed out of the room, closing the door behind him.

Regina gave a sigh that was half a laugh.

"Poor Decimus. He was the one who found you, lying on the floor behind the control bench. When he saw his face up there on the screen he was half convinced he'd frightened you to death. The doctor and I told him it was a side-effect of having taken one of my Wakeups and your own fault, but he had to see for himself that you were OK."

"But why was his face there?"

Regina threw up her hands. "Decimus gets nervous. The gate-viewer has about a dozen alarms wired into it. He happened to have a portable conference circuit, and he rigged a repeater so he could hear if any of them went off. The circuit puts his face on the screens of whoever he's conferring with; not his live face unless he's actually speaking, just an icon. The facility's built in. He didn't stop to disable it, just turned the intensity down, so that if the Gate-Viewer screen picked it up, it would be hidden behind the display. And it *was* hidden until you turned the brightness control right down. That blasted pill had made you abnormally sensitive to light."

Haru's eyes fell. "I should not have taken your medicine," she said humbly.

"I'll say you shouldn't. Those pills are tailored to *me*. I'm more than twice your weight and I've been taking Wakeups on and off for twenty years. These days I need them three times as strong as when I started. For a shrimp like you, one of my pills was a five-fold overdose. If Decimus hadn't heard you scream . . . oh, well, he did. But if you ever need Wakeups, get them tailored to your physiology—or better, do without. It took me a week to get over that last dose."

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"A week! How long have I been here?"

"A *lifetime* week—*my* lifetime. I spent it at a resort in the Main Continuum. Got back here the morning after I left, all ready for work, and found Decimus in a tizzy and you in the infirmary. Don't worry, you've only been here twelve hours, and half that time you were just asleep."

She appeared to listen; then spoke to something on the shoulder of her tunic; "Right, keep your hair on, I'm coming!", waved apologetically, and departed.

Haru crawled down to the lower part of the bed and slid to the floor. Twelve hours lost. . . . but she still had the use of the Gate-Viewer for about two days. Somehow, while she was asleep, her brain had come up with an idea about the probable time of spawning around a vent; at least she could check it out for future reference. But where were her clothes?

There were no drawers under the bed, no visible closets in the room; but there was a second door. It proved to lead into a bathroom. Haru made use of the facilities, including the shower, and then discovered a robolaundry set into the wall. Her clothes, clean and neatly folded, were inside.

She dressed quickly. Haru had no experience of infirmaries, but something told her that the longer she stayed, the more likely it was that somebody would come to interfere. She peered cautiously round the door, but there was nobody in that end of the room.

When she emerged, it was to see something beside the bed. It was vaguely manlike, but it glistened all over, and where the mouth should have been there was a blob of white.

A voice said, "Hallo, Haru. Has the medic said you can get up?"

Haru gulped. So that was what an isolation suit looked like. . . . She said, "Lio? "

"The same. I've neglected you, rather; but I got the impression you preferred to find your feet on your own. However, when I was notified about your pharmaceutical mishap, I thought it was time to see how you were getting along. How are you feeling now?"

"Foolish," said Haru truthfully.

"Fair enough. Also, there was something I wanted to ask you. Tell me about Professor Oe."

Haru gasped. "Why?" she said sharply.

"Because he sounds interesting. There was no reference to him in current traffic while I was at the Institute, but on general principles I used my remote to suck as much as I could out of computers and I've been taking a look at it. That's how I learned that Security hauled all his assistants in for interrogation, including you, a couple of days after he disappeared."

"*After?* But I thought—"

"You thought maybe you had told them something that got him into trouble? The medics said you talked about him quite a lot. No, I'd guess that what Security wanted to know was whether you and the others had any idea where he'd gone. The only record I found just said that you'd been questioned without useful result. So I suppose it's no use asking you now."

Slowly Haru shook her head. "I have no idea. How could he get away?"

"Mm. So he was a prisoner like the rest of you?"

"Not a prisoner . . . but he could not leave the Institute."

"How would you define a prisoner, I wonder? Never mind. Tell me about this project you're working on."

The infirmary had a clock, like everywhere else. Haru glanced up at it. Time was running out—not just lifetime, but the time available for using the gate-viewer. She explained as succinctly as she could.

"So in fact the viewing was not good enough for the job," said Lio thoughtfully.

"No, but now I have an idea—perhaps I know when the animals would be

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sure to spawn, but it is too late to try."

"How much time would you need?"

"It would have been better to use it right at the start."

"How about if you could have used it instead of falling down and scaring Decimus Chan?"

"I would have had more time than there is now. Perhaps enough. How do I know?"

"Yes, well . . ." Lio got to her feet. "I've got a few arrangements to make. *Don't* go away. Especially don't go anywhere near the room with the Gate-Viewer in it—that could ruin everything." She whisked away.

During the next half hour Haru got to her feet three times, and each time sat down again. A medic came and spoke to her about Wakeups, repeating what Regina had said, but at greater length. He said she could leave now, but she decided not to.

After about forty minutes Lio burst in.

"Come on, I've fixed everything." Outside was one of the spidery self-propelled vehicles used when there was some distance inside Elsewhere to go. Regina was sitting in it, grumbling.

"Yes, I *do* need you along. Don't worry about Decimus—you'll be back with him two minutes after you left." Lio pushed Haru up into the car, climbed after her and set the thing going.

Their destination proved to be a room just like the one which had been Haru's first introduction to Elsewhere, but with a young man in it tending the controls. Lio nodded to him and he pulled a large lever projecting from the far wall, which turned somewhat misty. With a firm hand on Haru's arm, Lio ushered her through it. Regina followed.

They were in a large room with walls of polished wood. It seemed that they had come right through one of these—Haru could not make out a door—but the occupant seemed unsurprised. He unlocked a door on the far side and they went through into a room just like the one they had left. This time Lio threw the lever herself.

They emerged into a corridor, right opposite a clock. It showed the same day's date, but at a time just short of two in the morning. Lio held up a hand.

"We're a minute or two early. Round the corner here, and keep quiet."

A few seconds later Haru heard faint sounds somewhere ahead. Peering round the corner, she saw a vehicle like the one they had been using, but longer. Two men were loading a stretcher on to it. Decimus Chan appeared, looking strained. He and both men climbed into the car and it whirred away.

"Right," Lio said. "Let's have a look at this machine."

In the event she stayed in the doorway with Haru, while Regina, muttering irritably, removed the plastic covers from several extra controls. Decimus Chan's face looked down impassively for a minute or two, then vanished as the screen brightened to the familiar green.

Lio whistled. "You mean you could make something out of *that?*"

"The eyes adapt," Haru said.

"Well" said Regina a few minutes later, "what am I supposed to be looking for?"

"I need . . . the moment when the Earth-side vent is choked off. When it begins to go cold."

"How long does that take?"

"I have no idea. How old is the vent?"

"Don't know. We'll start with a century."

The left-hand half of screen went into rainbow mode. Regina fiddled briefly with the temporal control and it turned black.

"Not that long, then. Fifty years coming up."

The screen was still black. At twenty-five years, however, it blazed with color again. Regina hopped the time to and fro, halving the intervals, until she reached a point where the false colors vanished between one month and the next.

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"Right. What now?"

"Oh . . ." How did Haru know what moment was right? "One week before it is quite, quite cold."

After a little more juggling, the screen showed a chimney in blue, fading to green. The red had shrunk inwards to a narrow band.

"That do you?"

Haru drew in a deep breath. "I think—two days forward." This time the chimney was green, fading to yellow at the top. "Yes . . . now open the gate. Please."

The screen showing the Downside vent had remained green throughout. Opening the gate made no visible difference. Why should it?

Haru looked up at the clock. She still had the use of the gate for about forty-three hours. Was it long enough? Should she have chosen a later day, allowed more time for the fertilized ova—if there were any—to develop into larvae, some of which might be carried in the slow current through to Downside's vent?

No way to tell. She said, "Thank you. We can leave it now."

"You think the worms'd free all the eggs and sperm they had, when they felt the vent dying under them? Was that it?"

"Yes. It is possible. Many marine animals do so when they are injured, or conditions turn bad."

"The selfish genes ensuring their own survival, or trying to," said Lio thoughtfully. "It makes sense. Now, I'd better get Regina back to her proper placetime. How about you?"

She could, Haru realized, simply go to her apartment. There was no danger of meeting herself, or anyone who would be puzzled to see her around. She said, "I will go home."

The living-room of her apartment was different, somehow. The screened enclosure in which she spent most of her time looked . . . unnecessary. She decided to ask for the screens to be taken away. Many of the people in the lab talked about tanks of fish or lizards or butterflies; perhaps she should get something of the sort. She went into her small kitchen and dialed a meal; just rice-gruel and fruit, but it was the first time she had used any equipment except the kettle.

It was still afternoon; but, after all, she was convalescing. She wandered into her bedroom and lay down. This bed was just right. Presently she was asleep.

She spent the following day in the lab. Her tenure with the Gate-Viewer ended tomorrow morning; she was determined not to waste time wondering whether she had changed the stony vent in Downside's ocean into a center of abundant life, or not. She worked a full day, and spent the evening watching videos of the Amazon rainforest from a sofa at the end of the room. All the same, she found it difficult to get to sleep.

Next morning she went early to the room where the Gate-Viewer was housed, and found Regina already there.

"Thought you'd be here soon," she said in a neutral tone. "So I didn't switch the Downside Viewer forward, yet. How far should I go?"

"How far?"

"In time, I meant. Ten years? Fifty?"

"Go forward—" Haru stopped, biting her tongue. If the introduction had worked, the longer it was left the better it should look. But if it had worked, and she chose a time after the vent had choked itself off. . . .

"Twenty years," she said, keeping her voice steady with an effort.

Regina tapped a key, twice.

The picture on the screen changed. First, and most obviously, the chimney had grown wider and taller. Haru's eyes were not yet fully adapted to the light. She thought—but she was not sure—

She pressed the minute-forward key—and something jumped on the screen. It was small, but its outline was hard, and the wiry things sticking out of

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it—

She said, under her breath, "It's a crab."

"And they live on the worms," said Regina, almost as softly. Then, at the top of her voice, "You've done it! You got them through the gate!"

"Oh, well done!" said a softer voice behind them. Lio was standing in the doorway. "Haru, I thought you would be here. Can you come outside?"

Rather unwillingly, Haru turned her back on the screen and stepped out into the corridor. Lio led the way briskly into a small office.

A man was sitting there. He was gray haired, with high cheekbones and a small pointed beard. He rose to his feet and bowed.

"Haru! So it was all true. I am most happy to see you again."

For a moment Haru's heart stopped. Then it went into overdrive. Hastily, she bowed.

"Professor Oe, I am—I am very happy also. Were—are—have you been here long?"

"Twenty days, I think."

Haru turned accusingly to Lio.

"All this time! When you asked me about Professor Oe—"

"When I asked you, I didn't know a thing," said Lio firmly. "But from what you said, there was obviously a chance he'd been recruited—on your timeline—or was going to be—on mine. So I postphased—went back, that is—and asked him how he felt about getting away."

"I told her," said Professor Oe, "that I would be very sorry to lose my assistants, especially you; but from the attitude of the Deputy Director, I feared that we were due to be parted shortly in any case.

"So I brought him through a Gate," said Lio cheerfully, "about three weeks ago—*Elsewhere* time, or last night in my lifetime, and left him in good hands. You wouldn't want to embarrass him by knowing your way around better than he did. But this morning seemed like the ideal time to bring you together."

"I congratulate you most heartily, Haru," said the Professor. "If you are not too busy with other things, I would very much value your help. There are still very many things I need to learn."

"Oh," said Haru, and collected herself. "Professor, I will be very glad to help you in any way I can. Elsewhere is strange in many ways, but it is a fine place to be, when one gets used to it." ■

[EDITOR'S NOTE: "Elsewhere" takes place in the same universe as "Hunted Head" (August 1995), "One Thousand Years" (May 2000), and "Out of the Fire" (March 2001).]

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Getting one's affairs in order is not necessarily an orderly process. . . .

A Star in the East

Laurence M. Janifer

The trick isn't not dying—that's too tough a trick. The trick is to buy the time to die of something else, later on.

Earth is supposed to be a dying world just lately—what with so many people having opted out for the home worlds or the colony worlds or just someplace else. The birth rate is down below replacement level (there are less than five billion people on the whole planet now), and every few weeks some 3V show does an obituary on the place: Nice enough world in its time, but its time is past, so goodbye and thanks for all the fish. And the rest of the ecology half the colony worlds have imported in.

I'm not so sure; like live theater or personal correspondence, its death has been reported too often to be taken seriously. But about Harald Ramses there was no doubt: his obit was being prepared in every newsfax studio and 3V warren on the planet, and on five or six other worlds as well. He was the reason I'd come to Earth—I'd resupply while I was on-planet, but it was Harald R. who had made the trip to this (theoretically) dying world necessary—and I'd arrived barely in time; Harald R., like all of us sooner or later, had run out of buying ability for time.

He lay in bed, at one hundred and twelve, looking about four hundred years old. He coughed once, making it sound like a formality, and said: "Nice of you to turn up, Knave."

"Least I could do," I said. "It's been some years—"

"Twenty or so," he said. "We met first at my retirement bash, and I asked you for a favor."

"Simple enough favor," I said.

"My fifth retirement bash," Harald R. said. "How many did I have all together, I wonder—and what's the record?"

"Sarah Bernhardt had three or four," I said, "back before even the twentieth century got going. And then there was—"

"I think I managed nine," he said. "Of course, I had more time than La Bernhardt—living to one hundred and twelve used to be a sort of miracle. Back near the end of the twentieth, a theatrical producer—and writer, and actor, and director—made it to a hundred and eight, and was still working at a hundred and seven. Surprised I have so much breath? I am."

"A hundred and eight, in the twentieth century?" I said, and then: "You

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sound perfectly fine."

"I sound like a wheezing barrel-organ," he said, "and you don't know what a barrel-organ is either, let alone the history of a man like George Abbott, who really did make it to a hundred and eight way back then. But the machine's wearing out, Knave, and all my studies, all my learning about the business, are gone to light fools the way to—well, you don't know that, either."

"To dusty death," I said. "I had some kind of classical education once." I wasn't about to tell Harald R. he was going to be fine and outlive us all; as a general rule, people who happen to be dying know better, and why waste their final hours in lying to them?

"So you did," he said, "so you did. And I'm very glad you're here—I was about to ask Peter for a favor, and Peter wouldn't have the faintest notion how to go about doing it." Peter had been his dresser, and was now, I suppose, his companion.

"Anything I can do," I said, and meant it. Harald R. had given a lot of people a lot of pleasure in his showy and glittering career as an actor, stand-up, director and occasional writer—and he'd been a good friend to Gerald Knave, which counted for more with Gerald Knave.

"You did me one once," he said.

"Very simple."

"You got rid of a damned blackmailer for me," he said. "Not so simple, as I recall. Now you have to get rid of a bomb."

I nodded. "A bomb. A bad script, a tape you don't want to leave lying around—"

"A bomb," he said. "Thing that ticks—this one doesn't, by the way—and, at the proper signal, goes bang. Destroying most of Fanciful East in the process."

Fanciful East in Connecticut—its twin was Fanciful West, someplace in New Mexico, I think—was one of those lavish gambling-and-entertainment casinos Earth used to be famous for, before even more lavish ones sprang up on Kingsley and the Reel. And Harald R.—he was always known as Harald R.—though he'd been a star at both places, was better known as the Star in the East. Now, apparently, he'd discovered that someone had put a bomb in the place.

I didn't know at the moment, of course, that the someone was Harald R. himself, and that he'd put the bomb in twenty-three years before. He told me that, there and then.

"Those were the days when I could still withstand modern surgery," he said. "No more: the signal's there for good, and I've begun to regret it."

The signal, it turned out, was a tight beam keyed to a tiny rig inside Harald R. that read his heartbeat. If that heartbeat stopped for one hour—allowing plenty of time for modern surgery in even a worst-case scenario—the bomb would go off.

"It's a very powerful bomb," Harald R. told me. "I was a very angry fellow, back around then—ah, well, I was young."

He'd been seventy-nine. "You were the Star in the East," I said.

"Indeed," he said. "And they did me dirty over a contract. Never mind the details—you wouldn't be interested, and now I'm on my deathbed I'm not very interested myself. It all seems very silly, in fact—blowing up an entire building—a building full of living people—over a contract dispute that turned out badly."

"Not quite a fully rational response," I said.

"Someone has to get to that bomb and disarm it," he said. "Disarming it's the easy part. The trick—the favor I want to ask you—is getting to the bomb, without letting the management know it exists."

I nodded, and considered for about a second and a half. "Why not tell them," I said, "and let them disarm the thing themselves?" Harald R. sighed.

"I find," he said, "that I have some love left of my own dignity. Silly, but there you are. I don't want it known that I connived at so silly a thing, Knave. I

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want to keep what dignity I have, for whoever it is who will study the lore of the business after I'm gone."

"So I have to go in and disarm the bomb," I said. "Quietly."

"Without letting anyone know," he said.

Well, what was I to do? A deathbed request, from a very old friend: of course I got all the details, and promised him I'd take care of things. "If you have a chance," he said, "come and tell me, when it's all done. I won't be shuffling off this oddly mortal coil of ours quite on the instant, you know—they give me a few days. But only a few."

It added even more interest to the job, of course: if the bomb was still armed and in place an hour after Harald R.'s death, it would not only take out Fanciful East, staff and customers alike—it was all too likely to take out Gerald Knave, too.

The bomb (he told me) was sitting in the private offices of the owner/manager of Fanciful East, a fellow named Harvey Grinspoon—hidden nicely behind an air duct. It had been sitting in the same place for twenty-three years—Grinspoon was a conservative type, and the offices had remained essentially the same all that while—just waiting for the signal of Harald R.'s heartbeat to stop. Then it would count down the minutes from 60, and bang.

Problem: get into the private offices of a gambling casino, stay there for the few minutes needed to disarm the damn thing, and get out—without bothering to inform any inhabitant of the casino that I'd been there at all.

Gambling casinos are not expansive, wide-open places, especially as regards the private offices of the owner/manager.

Well, there had to be a way.

I didn't have all year to fiddle with the job; I didn't have all week. Harald R., he informed me (and his doctors agreed, once Harald R. had told them it was all right to talk to me honestly), had something like three days of life left. It was impossible to get a figure any more accurate than that, though it would have been nice to have one—Harald R. might have appreciated a deadline (so to speak) down to the second, and God knows I would have—in the worst-case scenario, that kind of deadline would have allowed me to abandon the job, if finally impossible, in time to avoid being part of the eventual bang.

I spent the first part of that time thinking. Sitting around staring into space may not seem like the best way to spend deadline time on a rush job, but it is necessary not only to do something about a job, but to do the right thing—and the right thing generally takes some finding. I sat on my own gathering sense of impatience and began listing possibilities.

I'd been to Fanciful East now and then, and I'd save out enough time for a new look in case something had changed recently—but, as I've said, Harvey Grinspoon was a conservative type of owner/manager, and changes were not very likely. The main floor was full of glitter and game, and the second floor was almost as full of entertainment—two theaters, a movie house specializing in twentieth and twenty-first thrill-adventure, a small, intimate club that was almost an ancient cafe—and the offices. Those offices were supplied with the latest in the way of spy technology—from his desk, Grinspoon could see any table in the gaming rooms, any square foot in the cafe, any seat in the theaters or the movie house.

I knew this last bit because I knew just a little about gambling casinos, and assumed Grinspoon was a sane owner/manager. And it wasn't a helpful bit to know; a man with good spy technology is unlikely to want to leave it, no matter what the call.

My first thought was simple to the point of mania: pipe a nice sleepy-gas into the offices, wait the necessary cou-

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ple of minutes, and go in masked or shielded. Disarm the bomb, take it along as a souvenir, and report back to Harald R. Simplest thing in the world.

And unworkable, of course. Owner/managers of gambling casinos tend to be suspicious, even paranoid types, and therefore make sure they are guarded against such things as pipes for gas, or other such bothers. The gas itself is nicely invisible, but the piping is not, and hooking something up to fit into a keyhole or the small space under a door or something of the sort would get noticed.

Then I thought of the thrill-movies. Why not create a thrill-movie of my own? Hire some actors to come in and create a giant disturbance, in the course of which enough people would get careless, leave the offices of the owner/manager, and allow me the space to picklock my way in unseen, and a couple of minutes left over for bomb disposal. I had a fair slice of Harald R.'s money to work with, so hiring a lot of people could be managed without strain.

And that one sounded good, for all of fifteen seconds. But there were two problems with it, both fatal.

First, gambling casinos are used to disturbances of all sizes and varieties. Getting the employees, let alone the owner/manager, to panic and get careless would take something very special in the way of disturbances—an invasion by a full battalion of armed men might do it, but hiring a full battalion of armed men seemed just a trifle showy, though I could stand the expense—and there wasn't time to scratch up that many people, or a tenth that many.

There'd be a battalion's worth of people around Fanciful East after the bomb went off—fire and police persons, accident investigators, gawkers and, for all I knew, autograph collectors and performers with resumes—both types are hard to discourage. But that would be, if not too little, certainly too late. No.

Second, the area of Connecticut where Fanciful East resided was completely rural—small farms of all sorts, little plots of land with farm animals on them, houses and barns and all that kind of country life. Even if, somehow, I managed to find my battalion (and arm them with something or other, possibly pitchforks), I'd have to bus them in from whatever area I'd found them in—an area more heavily populated with rude aggressive types. An uprising of local farmers, even if I could arrange it, would net me about eighty fairly mild-mannered people, if I counted in women and children—a battalion would have to be imported, which would be, again, noticeable.

Again: no.

Thinking had failed me; it was time to go and look. So I went to Fanciful East as a simple tourist or customer, and wandered through the place, making a little conversation here and there. I talked idly to change girls (and guys), dealers at idle tables, floor managers, and other customers—just circulating around the place, dropping the occasional bit of money on one game or another on the main floor, and looking, not so idly, for an idea to jump up and bite me.

After a while—this was late on day one, and edged into day two—I wandered just as idly up to the second floor, and took in part of a buddy-cop movie, part of a chop-socky festival, and part of a show that convinced me that Fanciful East had gone downhill since the great days of Harald R.

No idea jumped up and bit me. Time was passing.

Then I ran into Elbert Whicher.

You'd think, from his conversation, that Elbert was an employee of the place—a dealer or a rather small-boned little bouncer, perhaps—but he was a simple, if not absolutely barefoot, customer, attached, when I met him, to a roulette wheel, which is one of the games that allow conversation while you're losing your money.

I'd fallen into chat with him because I

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was falling into chat with any- and everybody, looking for my big idea. And we got to talking about the place.

"It's the herd instinct," he said. "People come to Fanciful because other people come to Fanciful."

"If nobody came," I said, "nobody would come," and he nodded brightly.

"I mean," he said, as the wheel landed on Red 13 and we both stopped to sigh a little, "what's the sense in it? Come all the way to a place in order to look at a lot of playing cards or dice, and give some stranger some of your money."

"There are the shows," I said. "Some people just come for the cafe or the movies."

"So they say," he told me darkly. "But in order to get to them you have to pass through the gaming floor, and while you're passing through, you're going to stop, and drop a little money at a blackjack table or somewhere."

The wheel stopped on Black 6, and we both sighed again. "Or a roulette wheel," I said.

He placed a new bet, and shook his head. "Roulette's different," he said. "It's all mechanics, the way the wheel turns. Get to know a particular wheel—well, there's a system to it. It's not just senseless gambling."

"And you've got a system," I said.

"Of course I do," he said. "You don't think I'd just come here like one of the sheep, just to give Fanciful my money?"

The wheel stopped on Black 20, and we both sighed again, though I hadn't even placed a bet that spin. I barely noticed the number, in fact, and I said: "Good luck with it," to Elbert Whicher in an absent sort of tone, because he'd given me the idea I'd been looking for.

It was, of course, both a gas attack and a thrill-movie—in a way.

It was actually day three when things got moving—no help for it, and I only hoped Harald R. would hang on as long as possible—well, I rather thought he would: wouldn't you? But there were people to talk to, arrangements to make—all that talk from Elbert Whicher about the herd mentality and the people like sheep had given me the basic idea, but it wasn't anything like a simple idea.

Fanciful East was set in the middle of a rural community, but what it was used to, and what it was prepared for, was urban disturbance, so to speak—a sudden eruption of gangsters wouldn't have fazed the staff in the least. The usual sort of thrill-movie would have gotten very poor reviews.

On the other hand. . . .

I spent some time talking to a Willem Macnee, who owned a small farm full of rather large sheep only a mile or so from the Fanciful front door. (He also owned, apparently for home defense of some damn sort, a large, antique and perfectly workable bazooka-type weapon, which I immediately made arrangements to borrow. I had, even then, a notion about its eventual utility, though not against Fanciful East—not even to threaten them with.) The sheep turned out to be some breed or other that was startlingly expensive, or so Macnee told it—large, round, white and woolly creatures with black faces and rather remote expressions that combined thoughtfulness with dreamy idiocy. They looked like the faces of beings who could be led anywhere, at any time—which brought me right back to Elbert Whicher and his crowd of sheep coming to Fanciful East to gamble. I suppose that's where the metaphor came from originally; maybe you could lead sheep anywhere.

That you could lead them to that front door was a cinch, according to Macnee, if the proper payment was made beforehand; but of course I didn't depend entirely on Macnee. He had friends, and the friends had sheep, and what with one thing and another, it was four in the morning—which is a fairly active hour for a gambling casino—when ninety-six sheep marched up to the entrance of Fanciful East, and demanded entry.

They did this by going "baa" very

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loudly, in an irritated kind of way—sheep are not used to being awake and moving at four A.M., and neither are shepherds, or sheep-owners, or whatever the small pack of humans behind the sheep prefer to be called. Everybody was irritated, and anxious to get this whole thing over with.

The major-domo holding down the front-door post stared at this sudden invasion and said: "Now what the Hell?" in rather a mild voice, all things considered. Holding my borrowed bazooka in a nonthreatening manner, as idly as I could manage it, I said, in a louder and more commanding one:

"Charge!"

The sheep, instructed somehow or other by their human leaders, went for the door as if there had been positive vats of mint jelly somewhere beyond it. The majordomo got out of the way in a tearing hurry—people who aren't used to large animals (and these sheep were nearly the size of small horses) tend to think troubling thoughts when the animals charge anywhere in their general direction.

The sheep would never have harmed the poor fellow—they were used to getting out of the way of human beings—but of course he didn't know that, having had only the vaguest relationship to live sheep in the course of his chosen career. As he exited into the casino, he was shouting for help in an incoherent but very earnest sort of way.

The sheep, once into the place, simply kept going—encouraged by their humans now and again. Tables, wheels, chairs, whole buffets were going crash and bang all over the place; gamblers were setting new records for the hundred-yard dash, in any direction that looked sheep-free; dealers were forgetting their duties, change girls and change guys were dropping trays and joining the gamblers in their Olympic runs—and so on.

I got a few glimpses of this on my way to the second floor, which was a very hurried way indeed; I had to make it just in time.

And I did—just as three people, one of whom was Harvey Grinspoon, looked out of the opening door of the owner/managers office, saying things like: "What?" and "Huh?"

I was carrying a backpack, of course, and the backpack was holding a small flagon of sleepy gas, good for ten to twelve minutes, attached to a small hose. The rest, as they say, was silence.

The sheep were driven out of the casino by their owners and managers, with little loss—though Willem Macnee sang me quite an aria on weight loss among driven sheep, and Harald R.'s money was disbursed with some freedom. The bomb, whose disarming was simple, given Harald R.'s instructions beforehand, was a heavy but not impossible souvenir, and I made it back to the Macnee farm without much incident; Fanciful East was still in shock, with many, many people running in every possible direction, and one person carrying a backpack, a bazooka, and an unidentifiable large object made no impact on the scene whatever.

And Harald R. had the luck to be informed, by me, of all the events, before he shuffled off this mortal coil (as he said) to that bourne from which no traveler seems to return.

The Star in the East had set—had finally taken it (as he also managed to say) on the lamb.

And the bazooka?

I shoved the bomb into it, back a small distance from the mad hooraw that Fanciful East had become, having rerigged the thing to go off all by itself, about thirty seconds after I'd fired it into the air.

It made a brilliant display—and, as I told Harald R., it made an entirely fitting, entirely final star in the east. ■

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THE ALTERNATE VIEW Jeffery D. Kooistra

HISTORY IN THE MAKING

A good story, SF or not, is about the "most significant thing that happened." It need not be about the most significant thing that's ever happened, nor even the most significant thing that's ever happened in the protagonist's life. For instance, if your wife asks you how your day went, you would commence to tell her a brief story about what happened. The story might be about something your boss did, or that you did, or about something that nobody did but just happened. Specifically, your boss might have yelled at you for no reason; you might have sealed a deal that you'd been working on for a long time; a car might have jumped the curb and smashed into the building in which you work. Any of these three things might have been the most significant thing that happened to you that day, and hence you'd center your story on that event. But it is unlikely that you would bother to tell her that your boss had a cup of coffee (unless there was something significant about *that*).

Since we're all fans here, let's consider a few great science fiction stories. Some, like *Rendezvous with Rama* by Arthur C. Clarke, deal with first contact. Humanity's first contact with aliens would be so significant that it's spawned it's own subgenre. *Lucifer's Hammer*, by Larry Niven and Jerry Pournelle, is about the time civilization was nearly wiped out by a comet impact, a significant event by everyone's standards. *The Stars My Destination* by Alfred Bester is, at first, about how Gully Foyle tried to get revenge on the spaceship captain who left him stranded in the asteroid belt. This event was so significant to Foyle that it made a new man out of him. And, as Bester spins the tale, the stranding of Foyle ultimately leads to the (highly significant) remaking of the human species. And the recent novel by J. R. Dunn (who appeared here in *Analog* with a fact piece last December), *Days of Cain*, deals with some time travelers who want to change a significant event in history, the Holocaust, and some others who want to stop them.

I bring this up because at the moment I am (as were you) lucky enough to be a witness (and right when my next column is due) to HISTORY IN THE MAKING, to an event that will long be considered the most significant thing that happened in the year 2000. I am referring, of course, to the elections (in the USA) of 2000. I expect that by the time you're reading this, the election will be just a memory, starting to fade (and emotions will have settled), and the next president of the United States (whoever he is, but I expect it is George W. Bush) will be comfortably in office. But it isn't often that one gets to both *witness* a *bona fide* "historical event" while also *knowing* that one is witnessing a historical event as it unfolds, so I just can't pass up this opportunity to comment before the wave function of this moment collapses into memories (for me as it already has for you).

Science Fiction readers and writers, perhaps more than mundane non-SF types, are comfortable with the notion that there are critical turning points in history (a theme in the Dunn book). Almost all of the tales in the alternate history subgenre of SF are concerned with "what would have happened if" some signifi-

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cant, even critical, event in history had gone some other way. What would have happened if Kennedy (Lincoln, John Lennon) hadn't been assassinated? What would have happened if Hitler won WWII? What would have happened if the elections of 1960 had gone the other way? (*Analog* regular Shane Tourtellotte has a story making the rounds that deals with that possibility in an exceptionally thought-provoking way.)

What would have happened if the elections of 2000 had gone the other way? Someday someone, perhaps you, will write that story. In fact, I expect many writers to write stories about it. With this column, I intend to help you. Though all of you know how the election came out, I'm sure many of you have already forgotten some of the finer details of just what sorts of ideas and accusations, facts and misstatements of facts, are being bandied about during this time.

For instance, on election night, it looked like George Bush won the electoral college, while Al Gore won the popular vote. This forced everyone to confront the fact that the president of the United States is not elected via the will of the majority of US citizens, but via an indirect vote apportioned amongst the states. Naturally, the question arose as to whether or not the electoral college should be abolished as an antiquated system, unsuited to a 21st century nation, or whether it still has a valid and valuable role. Indeed, the newly elected senator from New York, Hillary Clinton, has already proposed abolition.

The truth of the matter is that trying to abolish the electoral college is pretty much a nonstarter. To achieve this would require amending the Constitution, and the less populous states would have to be peopled by complete idiots to approve it. (If the presidency was determined by who "won" the most surface area of the country, Bush would have taken Gore by dozens of square miles to one.) One thing that struck me election night as I watched the returns was how the states were divided up—the northeast quarter and the west coast were Gore's, while the heartland was pretty much all Bush's. And a closer inspection of the states themselves reveals that Gore won in the cities while the rural areas went hugely for Bush. Although this election result turned on the close races in several states, most notably in Florida, what was even more interesting were the wide margins in the other states. Some states went nearly sixty to seventy percent for one candidate over the other. But all that having been said, only about half of the eligible voters in the country actually voted.

These are just the kinds of details that a science fiction writer might take into account if he was contemplating writing a novel about what would happen if the US dumped its electoral college system.

So what are all of you waiting for? Start taking notes!

I'm serious. The only way to write a good story and have it connect with the readers is to make it a faithful analog to the world that the readers are familiar with. This means paying attention to detail. And the best way to accumulate details about what it's like to be in the middle of a major historical event is to live through one while paying attention at the time. Though I touched on the electoral college question above, you don't have to take notes just about that. You are still within half a year of a genuine, honest-to-God, textbook-and dissertation-worthy historical event. People's memories are still reasonably fresh. The newspaper accounts are yet easy to find. The talking heads on TV are still yapping about how things would have been different if the other guy had won instead of the one who did. (I started this column the day after the election—now, 21 days later and eight days past my deadline [who knew it would take this long?], Florida has finally certified Bush the winner. But lawsuits are still ongoing, so I'm not going to change "other guy" to either Bush or Gore.)

Pay attention to what people are saying about this event, since characters in any

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story you write will have opinions of their own. Listen for the nature of the arguments people put forth in support of their own viewpoint. Take note that some of the arguments are cogent and thoughtful, but many of them are pure nonsense. (Many of these latter arguments are put forward very articulately by lawyers who are making damn good money to win the rhetorical battle for their guy, and to hell with facts and reason. But then, it is the witness who swears to tell the whole truth, not the lawyer.)

Now, most of the gab-festers that get on TV get there because they have strong opinions. But you should also pay close attention to the attitudes of those who feel less passionate about the historical event. As I noted earlier, though Gore and Bush split about 100 million votes between them, about an equal number of eligible voters didn't bother to vote at all. Of those who did vote, not all care to dwell on what's happened since. I happen to be one of those who could watch news channels all day. On the other hand, while at PhilCon this year, I arrived at our room earlier than did Bud Sparhawk. I was watching election stuff on MSNBC (Fox News wasn't available, I don't like CNN, and "the Big Three" are a joke). When Bud showed up, the first thing he said to me was, "Turn that shit off!"

The lesson to be taken from this is that, even at events of historical importance, not everyone will notice at the time, and of those who do, not all will care. Only a very small subset will actually understand the greater ramifications of the event and the potential futures that could result, and even those futures that, because of the event, now may not. When Armstrong walked on the Moon, and even when the atomic bomb was dropped, there were many who just plain "didn't get it", both at the time, and later. Such people will also be around in any future you may write about—don't forget them. They may drive the plot and they may hinder the hero. They might be taught and turn out to turn the tide at the climax of whatever plot you spin.

At most historical events there are "players", in this case, the most obvious being Bush and Gore and their respective running mates. Sometimes the unexpected can happen to one of these players, like Dick Cheney's heart attack. No matter what outcome, the event has the capacity to change the players considerably. In the Tourtellotte tale I mentioned earlier, the Nixon found therein is much nicer than the Nixon most people think they know today. Also, there are often ominous signs and portents. In this election, I can't help but notice the undercurrent of mechanophobia ("A machine can't count a vote like a human being can—how can you trust a machine?") that has emerged from the Florida Supreme Court ruling. The Gore camp is playing on that idea for political reasons, but they're playing on it because it will work with some people.

I hope the above gives you some idea about the sorts of details you should bear in mind while writing about a historical event, either real or fabricated. Since this election was highly charged emotionally, I think it's right that I lay a few of my own personal political cards on the table. I did vote for Bush in this election, but not for his father either time he ran. I consider myself a conservative independent. (In some quarters, "conservative" is a dirty word, as is "liberal" in others. Read *The Politics of Prudence* by Russell Kirk [he also wrote SF] for better insight into what it *really* means to be a conservative.) I lament that I've never gone into a voting booth and had to decide between two *good* choices. Sometimes I vote Libertarian, because even when I think they're wrong, I usually think they're wrong in the right direction.

Now I don't know about you, but I for one am most happy that the election of 2000 took place in the waning days of the 20th century—I'd hate to have had it clutter up the 21st. I mean, this mess is just *soooo* last century. ■

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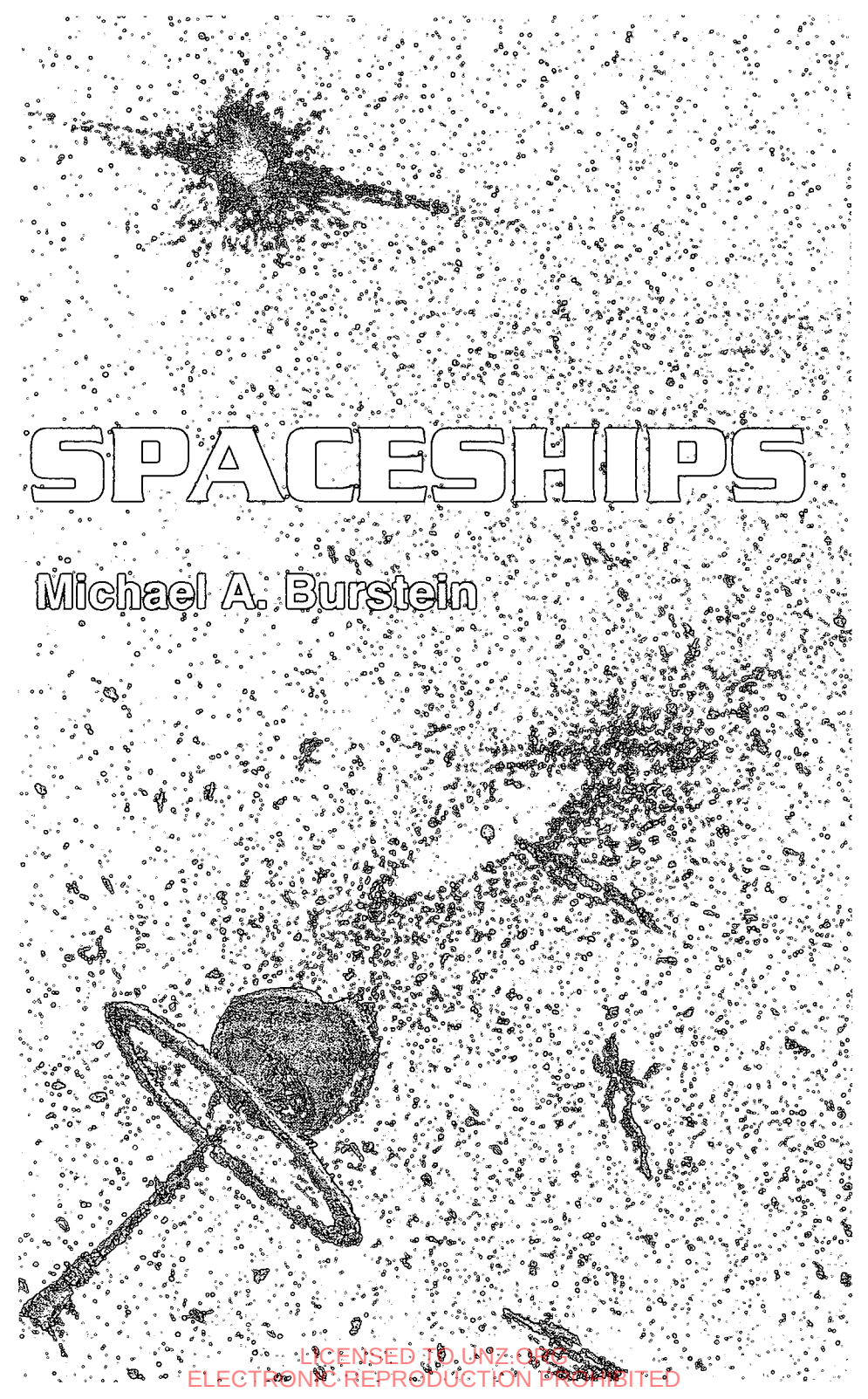
SPACESHIPS

Michael A. Burstein



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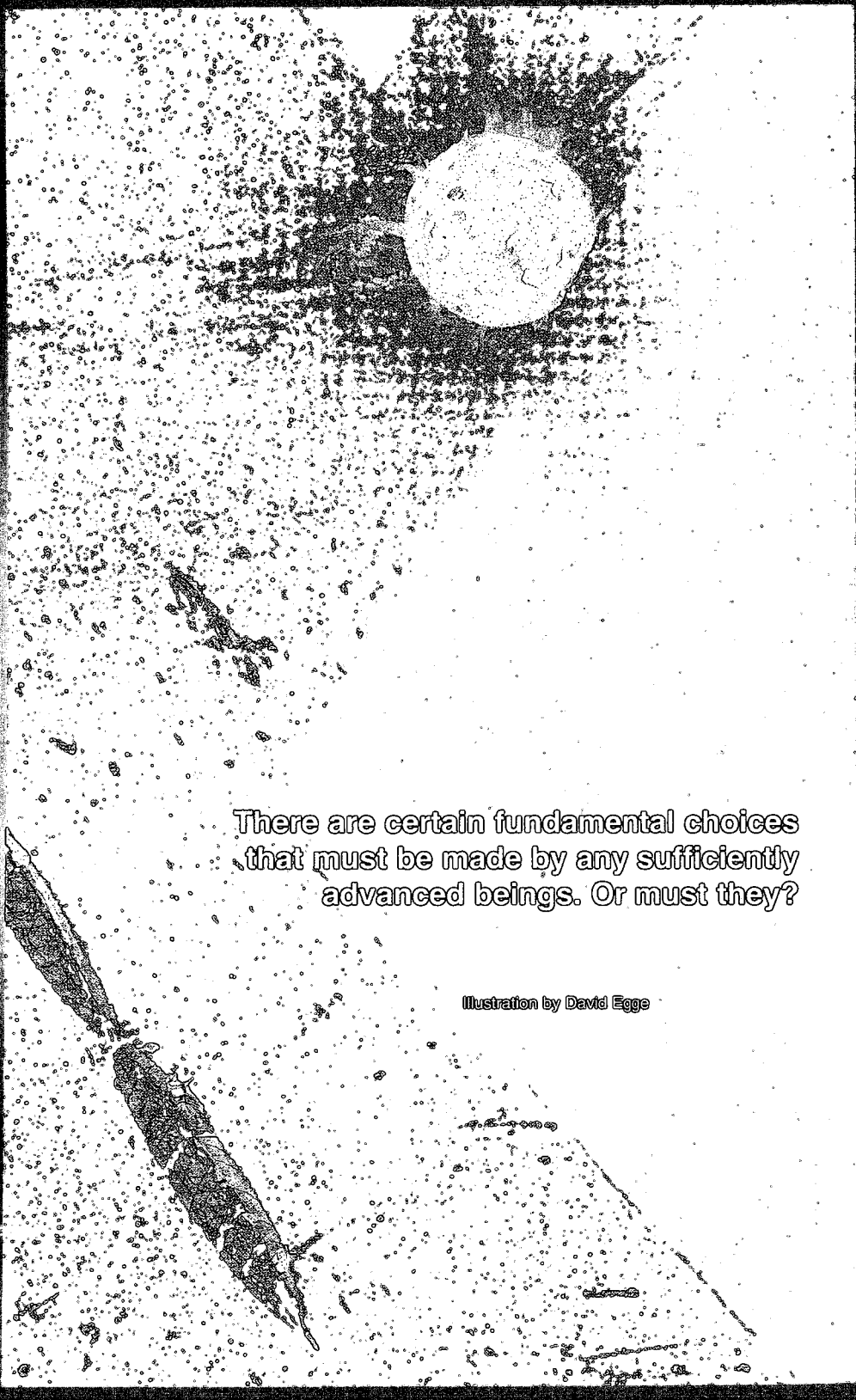

There are certain fundamental choices that must be made by any sufficiently advanced beings. Or must they?

Illustration by David Egge

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Morning, afternoon, and evening no longer existed, at least as far as Kel was concerned, despite just waking up from a long meditation. He awoke as always: floating in the darkness of space, among spaceships, a huge junkyard of them in orbit around one of the yellow-white stars of a binary system. Beyond lay nothing but empty space, and the distant stars of the galaxy, pinpoints of light sprinkled all around like—like—

Kel's Memory took a moment to locate the desired metaphor. *Ah, yes. Like dots of confectioner's sugar.* Such an ancient image. Humanity's ability to leach the necessary energy for life out of the quantum foam of the vacuum had rendered such things as sugar irrelevant, but perhaps Kel would recreate some, just for the experience. After all, Kel had retreated to this isolated system countless millennia ago, solely for the purpose of glorying in the ancient.

Another consciousness impinged upon his own, startling Kel into intense curiosity. He accessed his Memory again in order to calculate how long it had been, and with a shock discovered that no one had ever visited him in the long time he had been here. His last real interaction with others, as opposed to interactions drawn and replayed from his Memory, had been before he had chosen to isolate himself from the rest of Humanity.

The thought, *Fancy that,* came unbidden to Kel's mind. Surprise came next, surprise at the idea that another member of his race would actually be approaching. By longstanding agreement, the individual members of Humanity, as well as the group members, had agreed to give each other all the room desired, in both the Universe and in personal space. Nothing he could derive from his Memory led Kel to believe that this could be otherwise.

Unless, of course, things had changed, and his Memory was unable to project such a change, leaving it to Kel. Could the other consciousness be coming to—dare Kel hope—engage him in confrontation?

The consciousness was approaching the edge of what Kel considered to be his space, a volume consisting of a sphere about a light-year in radius. He could not allow it to get any closer without challenge, or he would be admitting that he did not consider his space—and what it contained—to be his own.

Do you have a name? Kel projected, and the visitor stopped dead in space.

Yes, replied the other. *Ria. I have come to discuss—*

Not now, Kel interrupted. *I would rather do this in person.*

Echoes of confusion reverberated from the visitor. *In person?*

Yes.

Now Kel felt shock from the visitor, who replied, *I don't understand.*

Kel felt exasperated; if he had been in a material body, he would have sighed. *You have come this far to converse with me. Therefore, whatever you may wish to discuss is of more importance to you than it is to me. If you wish to come further, it will be on my terms.*

But—

If you will not agree to my terms, then I must conclude that you wish to come no further, and our conversation is at an end.

For a long, unmeasured time, there was silence from the visitor, and had the consciousness not been so obviously hovering at the edge of Kel's space, he would have assumed that it had gone away rather than into meditation. Finally, the visitor projected assent to Kel's terms, but with a question.

I have not done this in eons. What sort of material body would you prefer I adopt?

This would be a good test. *Please yourself.*

In that case, replied the visitor, *I shall appear as I once was.*

Kel's estimation of the approaching visitor went up a slight amount. Some-

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one who remembered their original material form . . . this was someone Kel could understand.

I shall do the same, he replied.

The process of manipulating energy into matter, in order to recreate his own original shell for his consciousness, was a simple one. First, Kel accessed his Memory for his schematics, filed as genotype and phenotype. Then he pulled matter out of the vacuum energy and formed the vessel. He felt a pang as he studied the body, but he could not identify why.

One final thing was needed before the process would be complete. Kel created a bubble of oxygen and nitrogen gas, so as to keep the breathing reflex from causing the material vessel to die before he was finished using it. Having done so, he dove inside.

He blinked his eyes, cracked his jaw, and waved his arms around. He licked his teeth, which tasted metallic, and strained his ears, hearing nothing. Suddenly his body began shivering. The surrounding gases felt—what was it?—cold, that was the sensation—so he sped up their molecular vibrations until the body stopped shivering and floated in comfort.

How odd, to perceive the Universe in such a limited way! So few wavelengths of light, so few frequencies of sound . . . a momentary panic gripped him, a fear that he would be unable to leave the vessel behind, and would be trapped within it forever. He felt as if he was falling, faster and faster, his heart beating more, his respiration rate increasing—and then he remembered his meditations, and the panic subsided, as suddenly as it had come.

He closed his eyes and waited.

After a time, the visitor's presence impinged upon Kel's consciousness. He opened his eyes and scanned the volume of space around him.

Finally he spotted a figure, no larger than a point of light, flying towards him slowly but dexterously. As the visitor got closer, Kel discovered that the visitor's body differed from his in a few major aspects. By an interesting coincidence, they represented the two polar opposites that Humanity's individuals once tended towards.

Kel was male; the visitor was female.

He felt an irrational desire to abandon his body, or cover it up, and he accessed his Memory to understand why. When he came across the notion that nudity had been considered a private thing in many cultures, he understood. His own culture must have been one of those. Fortunately, with understanding came dismissal of his concerns. He dispensed with his desire to cover himself, and instead enjoyed the sight of another person flying in a straight path towards him.

She came in on a course that took her below his feet, and circled once around, studying Kel. Kel returned her gaze. Her vessel, if it truly was her original body, was an aesthetically pleasing one to Kel. She wore her lightly colored hair long and flowing, and a bluish tint was evident in her eyes.

Twice more she circled around, and then finally, she swooped in from below, settling herself so that their faces were level. They stared into each other's eyes for a moment, and then Kel spoke.

"Your name?" he asked. It felt unreal, the squeezing of air from his lungs through his throat in order to create sounds.

"As I told you before, I am called Ria."

"I was merely repeating the traditional greeting ritual. As for me, I am Kel."

"Yes, I know," she said, smiling.

Ria fell silent for a long time, which Kel found surprisingly unbearable. For someone to come all this way and not talk felt disturbing. Finally, he asked, "Why are you here?"

Ria held her head still, but her eyes looked all around. "Why do you suppose I am here?"

"I do not wish to play games."

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She looked back at Kel. "What else do you have to do with your eternity?"

"Answer the question," Kel said, and then his Memory suggested he add a word he had forgotten to his request. "Please."

Ria nodded, with a solemn look on her face. "I did not believe it to be so. But it is."

"What is?"

"All this." Ria swept her arm around in a complete circle, then another and another, until her fingers had traced out a whole sphere. "You really have spaceships here."

"Yes." Kel pondered a moment, looking around in all directions. His collection was indeed magnificent. Countless silver and gold spaceships reflected light from the two stars, shining in all their glory. It had been a long time since he thought about how this collection would look to another.

"Is that what brings you here?" he asked Ria.

She nodded. "That is what brings me here. An interest in your spaceships."

Kel studied her more closely, with his mind instead of his eyes. She seemed to have only one voice among her thoughts, but just in case—"Are you an individual, or a group?"

"I am but one," she said, looking off into the distance above his shoulder.

Kel turned around to follow her gaze; she was staring at one of the larger vessels, a giant spoked wheel, the first of the second wave of generation ships. He looked back at her face, and although he had not read one in a long time, he thought he could understand what it was saying.

She adored his collection.

Kel came to a decision, and for the first time, made an offer to a fellow Human being which he had never thought he would. "Would you like to see them?"

Ria smiled. "That is why I have come."

Kel had not really studied his collection in some time, and he could no longer enjoy it with fresh eyes, so he felt strongly tempted to invade Ria's consciousness and experience from her perspective directly. But she had not extended such an invitation, and etiquette would not allow him to initiate the request. Instead, he satisfied himself with experiencing it vicariously, by watching her reactions and attempting to mimic the feelings within.

They started with the shuttles.

"These are short-range craft," Kel said, "designed only to stay within one planetary system. Notice how most of them are rounded on top, but flat on the bottom, so they can function easily in both vacuum and atmosphere."

Maintaining a physical existence had its limits, as Kel and Ria had to fly in all different directions to examine shuttle after shuttle. But it had its advantages as well; Kel noticed that being in a body allowed him a greater appreciation of the difference in scale between a ship and a Human.

"What are those?" Ria asked, pointing in a direction opposite the two stars of the binary system.

"Ah," Kel said, and they flew towards the ships indicated. "Those are the ships designed for travel within a solar system. Over here I have placed the smaller exploratory vessels, and over there are the colonization ships."

Ria glanced briefly at the smaller vessels, then flew over to the colonization ships. Most were of the same design—huge cubes with access hatches ranging from a meter wide to the size of the shuttles scattered around its surface.

"Could these land?" Ria asked.

"No, of course not," Kel replied. "These ships were designed to transport an entire colony from one planet to another. They would be constructed in orbit around one planet, loaded from the ground, and then unloaded once in orbit around the second planet. Then they'd be piloted back for more colonists and supplies."

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"It seems too time-consuming, so wasteful."

Kel smiled. "If you can, remember what life was like back then."

"What do those markings mean?" she asked, pointing.

"They are the ship's names. Access your Memory and you can read them."

She nodded, and after a moment she began reading aloud, moving her head from side to side to make out the markings. "*Pioneer—Voyager—Apollo—Challenger—Discovery—*"

Kel interrupted her recital. "The names have a fascinating history in their own right. Many were used over and over again."

"But that would defeat the uniqueness of the ships," Ria protested.

Kel had nothing to say to that. Instead, he flew away from Ria in a direction he arbitrarily considered upwards, as it was away from the geometric center of his collection. He sped past the long-range ships, the ones outfitted with hyperdrives, and jump drives, and wormhole generators, and space warpers, and all the myriad engines Humanity had devised merely to get their meat to the stars.

He looked back once, verifying that Ria was following him. He felt no wind as he flew; his bubble of gases flew with him.

He came to a stop near a huge metal engine, glistening with an oil sheen and covered with indentations and pockmarks.

"That one," he said, "makes me dizzy when I think of it."

Ria studied it. "It's too small to be a ship."

Kel nodded. "It's not. It's a bubble engine. It was used to carry whole cities into space."

Ria's eyes widened. "Is it—"

"Yes. The precursor to our manipulation abilities. The engine that rendered all this, and itself, obsolete." He paused. "We can turn it on, if you like. It is still functional."

"I see no need to do that," she said, once more looking all around. "After all, there is nothing it can do that we cannot."

Kel felt disappointed that Ria did not want to see the bubble engine in action, but the disappointment faded when she said, "May I ask you about certain other ships?"

"Certainly," he replied.

"Tell me about that one," she said, teleporting the two of them next to a round, saucer-shaped craft, with circular portholes evenly spaced around the rim. Undergoing physical teleportation disoriented Kel for a moment, but he quickly recovered and examined the ship. Then he laughed. "That one was a joke."

"A—joke?" It appeared to take Ria a moment to grasp the concept. "A spaceship was a joke?"

"Yes. It is meant to mimic the ships that aliens supposedly visited Earth in, before the days of spaceflight. The term was flying saucer."

Ria nodded, then asked, "What is that one?" She pointed at a craft at the edge of their sight. Kel craned his neck to examine it: a long cylinder, which tapered at one end, and at the other end had four fins evenly spaced around the edge.

He laughed. "That's a classic design, but it never flew. It's not really astrodynamic."

"Then why do you have it?"

"I keep it here as a reminder." He paused, not sure if he wanted to ask the next question. "Now, tell me why these were of interest."

"I see them prominently in your mind. They have some significance to you."

They are my favorites, Kel thought to himself. The violation of his personal thoughts upset him. He wondered why Ria had bothered.

"Tell me," Kel asked, "what is the Universe like in this time?" Perhaps Humanity now considered her behavior acceptable.

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Ria's face displayed puzzlement. "The Universe is isotropic and homogeneous," she said. "It is like it has always been."

Kel sighed, an affectation of being in a body. "I meant Humanity. What is Humanity like in this time?"

"You do not know?"

"I turned my back on the race a very long time ago. You are the first one I have communicated with since that time."

"Oh." She paused. "Humanity is as it has always been, I presume, ever since we became what we are."

"There is still respect?"

Again she paused. "Yes."

Then why did you violate my individuality? Kel thought, but chose not to ask that particular question out loud. Instead, he asked, "Respect for all things?"

Ria looked away momentarily, then faced him again, smiling. "The spaceships are beautiful. I would like to—what is the concept?—acquire them from you?"

Kel was taken aback by the non sequitur, both for the change in subject and for its forwardness. "Acquire?" he asked. "What do you mean by that?" He knew the word, but did not understand what she wanted.

Ria closed her eyes, presumably accessing her Memory. "Purchase. Buy."

These words were unfamiliar, and they echoed in Kel's mind. He accessed his Memory for meaning. It reminded him of concepts such as money and capitalism, and a time when Humanity engaged in things called trade and commerce.

"Buy?" he finally asked. "You make no sense. Why? What is there to trade?"

She seemed to ignore his question. "These are unique. Truly so."

"You can construct your own."

She shook her head. "It would not be the same. Would you accept my constructs, even if I engineered them to be exact down to their strings?"

Kel nodded. "I understand your point. But I do not understand your desire."

"Is it not the same as yours? To—to *own* these ships?"

"That was never my desire. If you wish to own them, you may share them with me." He pondered for a moment. "Besides, what can one person possibly offer another? What could you offer me that I could not create myself?"

"I can offer you fame," she replied.

Kel swallowed hard; this was the last thing he was expecting to hear. "Fame?" A long time ago, Kel had craved it, but he had finally learned to reject it. After all, with literally trillions of consciousnesses in the universe, no one could ever come to fame.

"You are the Kel of whom I have heard, are you not?"

"You have heard of me before? And yet you offer fame? I am surprised that anyone would have mentioned me. What have you heard?"

Ria stared into his eyes. "You are not mentioned frequently, but there is a reference in one of the group Memories. A legend. It says that you disappeared long ago, to tend to spaceships."

"You should not trust everything you access from a group Memory."

"I knew you would say that. The legend also says you rejected all Bondings offered to you."

Kel did not need to access his Memory to recall that. "Perhaps some things can be trusted. But you are still not answering my question. Why do you want my spaceships?"

"Because I value them as you do."

Kel shook his head. "You cannot lie to me, even in this form."

She sighed. "I wish to destroy them."

"What?"

"Kel, these are the last remnants of what we once were. They are old, outmoded, useless. Their matter would be better served if transformed into energy. It is time to put them to an end."

He stared at her for what seemed like an hour. "You are a fool," he finally said.

She shook her head and waved her

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arms all around. "The Universe has moved beyond you, Kel. *Humanity* has moved beyond you. Spaceships are unnecessary, irrelevant. Why do you persist in this irrationality?"

"You are not who I thought you were."

"No, I'm not," she agreed. "But you are everything I expected."

"You may not have my collection. Now go," he said, pointing off into space.

"Please let me explain."

The word "please" reached him. "I will hear your explanation."

She bit her lip and nodded. "I lied before, when I said I was an individual."

"What do you mean?"

"Once, I was part of a group. I am no longer."

Kel shuddered in horror; *strange*, he thought, *how the body remembers its reactions*. Kel had rejected the sacrifice of his individuality to a group, and here before him floated someone who had apparently embraced it eagerly. "The loneliness must be unbearable," he said in attempted sympathy. "I can only imagine."

She glared at him. "No, you cannot. Don't even try."

He nodded, and she continued. "I have been offered a chance to Bond again, if only I eliminated the last vestiges of what we once were."

Suddenly Kel understood. "The spaceships."

She nodded. "The spaceships. No group would Bond with me unless I could demonstrate that I would not demand my individuality back a second time. But if I am willing to do this—"

"And are you?"

She looked away. "I am. It is the only way I can become Human again."

To Kel, the idea that Ria would only consider herself Human if part of a group was monstrous. "It is not the only way."

"What?"

"I offer you another choice, another way to be Human." *The only way to be Human.*

"Which is?"

"Stay with me. Learn the value of being only two, and not many."

She stared at him with a puzzled look on her face. "Are you offering me a Bonding?"

As before, when contemplating Bondings, a chill of horror permeated Kel's body. It echoed with the memory of the many times he had rejected Bondings.

"I cannot offer a Bonding, Ria. But I can offer a bonding, in the old way."

For a moment, it looked as if Ria was shocked, and she seemed on the verge of flying away. But then she smiled, and closed the short distance between their bodies.

"Show me," she said.

Kel began slowly, taking Ria's surprisingly warm body in his arms. She tilted her head, and Kel placed his lips upon her mouth, which tasted sweet.

As they held each other, Kel accessed his Memory, to be sure he knew what came next. The irony of needing to do so in order to complete the bonding irked him, but he had little choice. He had not needed to know this in so long that there had never been a reason to keep the physical movements at the forefront of his consciousness.

He felt regret at the same time their bodies came together in the rhythm that he had not remembered, or needed to, for far too long. Kel could feel pleasure anytime he wanted, of course; but to surrender oneself temporarily to another in the most ancient dance of all had a joy all its own. Kel and Ria moved together, over and over. Finally, he felt an explosion of pleasure—and again—and again—

And then he realized that the two of them were not the only things exploding.

He pushed her away and gazed around at his ships, which were silently blowing apart in the vacuum of space.

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The ones further away looked like tiny supernovas, blazing away before finally dissipating. The closer ones glowed briefly and brightly as their matter instantaneously became energy.

Kel realized suddenly that Ria had been tricking him, and he raised his hand and slapped her across the face. "How dare you!"

Ria massaged her jaw, and stared back at him blankly. "I dare because I must."

He spat at her. "You had no interest in bonding. You merely wanted to distract me. So you could complete your task."

"It was the only way, Kel. Now I will be acceptable for the Bonding."

He clenched his fists, frustrated at the uselessness of the anger which choked him. "Do you know what you have done to me?" He hoped to see tears in her eyes, a head bowed in shame—any sign of remorse. He wanted her to apologize, to feel humiliated, and to see the error of her ways.

Ria merely floated there, a faraway look in her eyes. "What does it matter?" she asked. "If you wish, you can recreate the exact same forms, down to their strings."

"You know that they would not be the same."

"Yes, they would. They would merely not be the same to *you*."

Kel pointed at her. "Then why did you not create your own copies, and destroy those instead of mine?" When she didn't answer, he continued, "It matters to the Bonding members, doesn't it? It had to be the real, original ships, or it would not count. Even as all of you reject the old ways, you acknowledge their power."

She shook her head. "The old ways do not work anymore, Kel. I have moved beyond them. All of Humanity has, except for you." She gestured at their two bodies. "These bodies are inefficient. You are clinging to an irrelevant past."

"We must value the past—"

She interrupted him with a thought. *Why?*

He had never questioned it before; and so for a moment he had no answer to give her. When one came to him, he deliberately spoke aloud, and not through thoughts. "We just must. If we forget the past, if we abandon our roots, we forget who we are."

She stared sadly into his eyes. *Kel, you lost that battle eons ago. Humanity lives in the now. As—as must I.*

Her body spasmed, and suddenly Kel knew that she no longer inhabited it. He looked into the empty vessel's eyes, which stared back without recognition. He looked more deeply, and thought he saw the glistening of unfinished tears in her eyes.

More likely, he was just fooling himself.

"Farewell, Ria." He captured the image of her body into his Memory, and with a thought transformed her vessel of matter back into energy.

With only slight hesitation, Kel destroyed his own body as well. He did not want to feel the tears that might otherwise form in his own eyes. After destroying his body, he returned to the center of his graveyard, the better to study the full extent of the damage to his spaceships.

His next step was obvious. Painstakingly, Kel accessed his Memory, and with his thoughts, began reconstructing his collection of spaceships. He noticed that, rather than destroying all his ships completely, Ria had left a few pieces of matter scattered about from each one. Perhaps, Kel mused, he had reached her on some level after all. ■

A moment's insight is sometimes worth a life's experience.
—Oliver Wendell Holmes

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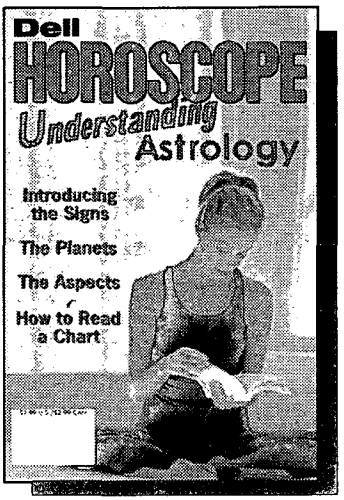

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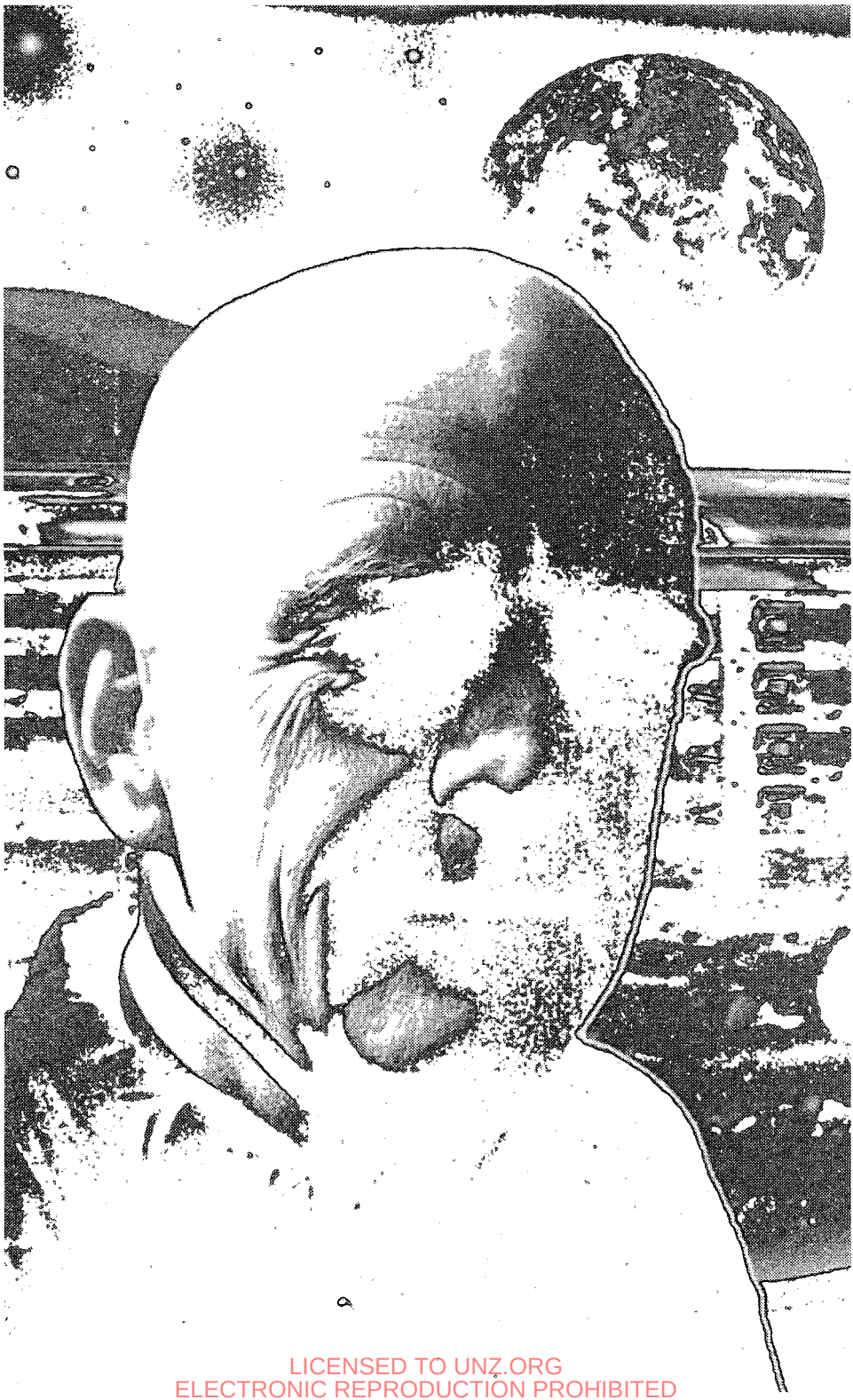

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The keys to solving very large problems can be very small. . . .

The Precipice

Part II of IV

Ben Bova

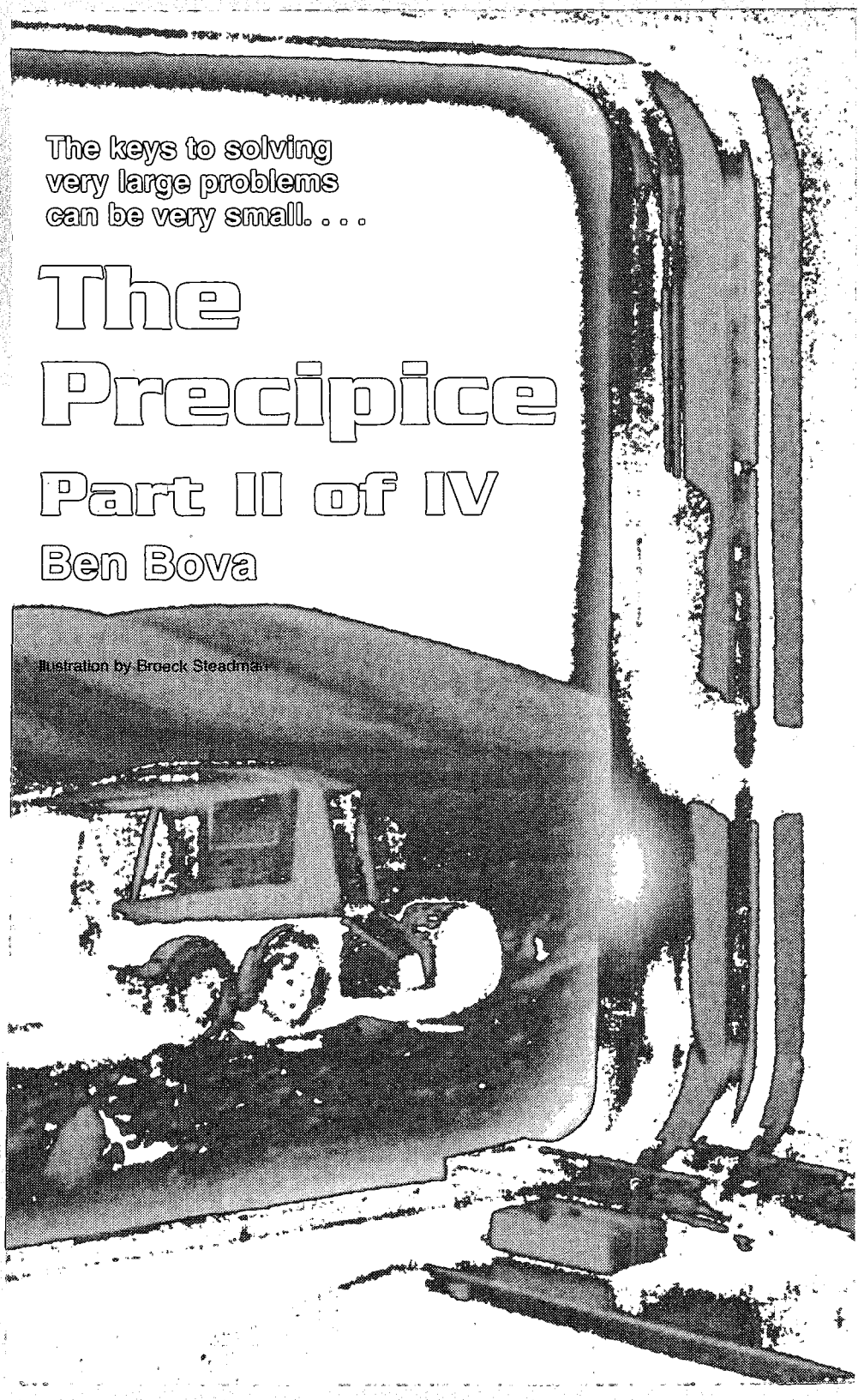

Illustration by Broeck Steadman

Earth's climate has plunged over the Greenhouse Cliff. Sudden, disastrous warming has abruptly raised sea levels worldwide, flooded most coastal cities, and is turning croplands into deserts. Tens of millions are homeless; hundreds of millions face famine.

Dan Randolph, founder and CEO of Astro Manufacturing, Inc., wants to use the resources of the Asteroid Belt to help the battered, beleaguered people of Earth. But the costs of reaching the Belt, out beyond the orbit of Mars, doom his hopes to financial failure.

From his home in Selene, on the Moon, Martin Humphries sees Earth's catastrophe as an opportunity to gain wealth and power. He wants to acquire Dan Randolph's company, Astro Manufacturing, Inc. To lure Dan, Humphries offers to finance development of a fusion-powered space drive that will make it financially feasible—even profitable—to mine the rich resources of the Asteroid Belt. Devil-may-care pilot Pancho Lane is the sharpest astronaut on Astro's payroll. Humphries enlists her to spy on Randolph, who has assigned Pancho and the lusciously beautiful Amanda Cunningham to test-fly the first fusion-powered spacecraft. Pancho reluctantly agrees to spy for Humphries; she needs the money to support her sister, who is in cryonic suspension, waiting to be revived and cured of the cancer that led to her clinical death.

But Pancho finds she can't be disloyal to Dan Randolph. When she reveals to Dan that Humphries wants her to spy on him, Dan laughs and tells her to go right ahead. But he sends Pancho and Amanda to Selene.

SELENE

Pancho had no trouble getting through customs this time. The same inspector went through her bags perfunctorily, not even blinking at the mice in their sealed plastic cage.

But he paid elaborate attention to Amanda. Pancho groused to herself as the inspector carefully went through Amanda's travel bag, alternately grinning at Mandy and reddening as he saw her lacy underclothes.

He'd strip search her if he could find the slightest excuse, Pancho thought, fuming.

Mandy simply stood on the other side of the table, looking wide-eyed and innocent while she kept up a constant nervous chatter.

"I don't know why they always go through my bag, Pancho. I really don't. You'd think that after all these times we've come to Selene they would simply let me pass through without all this bother."

"He went through my bag, too, Mandy," Pancho replied.

"Yes, but he didn't paw through your underwear."

Grinning with gritted teeth, Pancho said, "Yours are a lot purtier than mine."

The inspector kept his head down as he searched diligently through Amanda's one piece of luggage, but Pancho could see the back of his neck turn beet red.

"All the other passengers have already gone through," Amanda noticed. "We're the last ones."

"The rest of 'em are either up here to start a long-term work contract or they're tourists. We come and go all the time, so we could be smugglers."

"Smugglers?" Amanda looked shocked. "Us? *Me?*"

Pancho reached across the table and tapped the inspector on the shoulder. "Ain't that right? What're you looking for—dope or contraband seeds or maybe illegal bottles of air?"

The inspector mumbled something incomprehensible.

At last he finished and pushed the bag back across the table toward Amanda.

"There you go, Ms. Cunningham. Sorry to have delayed you. I'm just doing my job, miss."

Amanda thanked him politely as she

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zipped her bag shut and hefted it to her shoulder. Pancho saw that the inspector couldn't help but stare at Mandy's expansive chest. Even in a standard-issue flight suit she looked sexy.

Visibly working up his courage, the inspector said, "Um . . . Ms. Cunningham . . . could I take you out to dinner some time while you're here?" He made a sweaty smile. "To, uh, make up for inconveniencing you and all."

Mandy smiled sweetly at him. "Why, that would be lovely. Call me, won't you?"

"I sure will!"

Pancho seethed as the two of them left the customs station and headed for one of the electric carts that carried new arrivals through the tunnel from the spaceport into the underground city. He asked me to dinner when I was alone, but with bimbo boobs here, he never even saw me. I could've carried the Eiffel Tower up here and he wouldn't have noticed.

The message light was blinking on their phone by the time they got to the quarters they were sharing. When Pancho had first come to work for Astro Manufacturing four years earlier, pilots still got private quarters when they worked on the Moon. Not any more. The rumor back at La Guaira was that Randolph was going to rent a dormitory area for the spacecraft pilots and crews.

Why not just fire all of us? Pancho wondered. If Randolph had any real sense, he'd talk the IAA into getting rid of their stupid regulations about keeping human crews aboard the ships.

Yeah, fine, she answered herself. Then what do you do? Get a job as a mission controller? Fat chance!

As soon as they opened the door to their quarters, they saw the phone blinking on the nightstand between their two beds. Amanda dropped her bag on the floor; it landed with a gentle lunar thump as Mandy stretched out on the bed and put the handset to her ear.

With a surprised look on her face, Mandy held the phone out to Pancho. "It's for you," she said, as if she didn't really believe it.

Pancho took the handset and saw on the phone's tiny console screen that the caller was Martin Humphries. Rather than activate the speaker, Pancho put the handset to her ear.

"Pancho, is that you?" Humphries' voice said, sounding annoyed. "You're standing outside the camera view."

She stepped between the beds and swivelled the phone console. "It's me," she said, sitting on the bed opposite the one Mandy lay upon.

"I heard that Randolph sent you up here," Humphries said. "But I had to learn it from another source. I haven't heard a peep from you in months."

With a glance at Mandy, who was watching her with intense curiosity, Pancho replied guardedly, "Well, I'm here now."

"Who answered the phone? You're not alone, are you?"

"Nope, I'm here with Mandy Cunningham."

"She's an Astro employee too?"

"That's right."

Mandy was straining to see Humphries' face, but Pancho kept the phone turned away from her.

"Well, I've got to talk to you. I've been paying you for information but so far I've gotten nothing from you but a big, fat silence."

Pancho made a smile. "I'd love to see you, too. I've got a lot to tell you."

Humphries snapped, "All right, get down here right away."

"You want me to come to dinner?" Pancho replied pleasantly.

"Dinner?" Humphries glanced at his wrist. "All right. In two hours."

"Tonight?" Pancho cooed. "That'll be just fine. I'll see you at nineteen hundred. OK?"

"Seven o'clock," Humphries said. "Sharp."

"I'll be there."

Pancho hung up the phone and said

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to Amanda, "I'll use the shower first, Mandy. I've got a dinner date."

She left Mandy standing by the bed, staring at her with wide-eyed astonishment.

Two weeks later, Amanda and Pancho were exercising in Selene's big gymnasium complex, working up a fine sheen of perspiration on the weight machines. Through the long window on one side of the room Pancho could see two men strapped into the centrifuge, both of them grimacing as the big machine's arms swung round and round, faster and faster. She knew one of the men, a maintenance tech out at the tractor garage, a thoroughly nice guy.

The gym was packed with sweating, grunting, grimacing men and women working the treadmills, stationary bikes, and weight machines. The only faces that didn't look miserable were the kids; they scampered from one machine to another, laughing, sometimes shrieking so loud the adults growled at them.

Every person in Selene, adult or child, citizen or visitor, had to follow a mandatory exercise regimen or be denied transport back to Earth. The low lunar gravity quickly deconditioned muscles to the point where facing Earth's gravity became physically hazardous. Daily exercise was the only remedy, but it was *boring*.

Pancho wore a shapeless tee-shirt and faded old shorts to the gym. Amanda dressed as if she were modelling for a fashion photographer: brand-new gym shoes, bright pink fuzzy socks, and a form-fitting leotard that had men tripping over their own feet to gawk at her. Even the women stared openly.

"Who's your boyfriend?" Amanda asked.

"I don't have a boyfriend," Pancho replied, grunting as she pulled on the weighted hand grips. A favorite gambit of tourists was to have a picture taken while lifting a barbell loaded with enormous weights. What looked superhuman to Earth-trained eyes was merely ordinary in the one-sixth gravity of the Moon.

"You've gone out to dinner twice since we arrived here, and you're going out again tonight, aren't you?" Without waiting for an answer, Amanda added, "I have the impression it's been with the same fellow each night."

Mandy was sitting at the machine next to Pancho, doing pectoral crunches, her arms outstretched with her hands gripping the ends of two metal bars. Then she brought her hands together in front of her, pulling the weighted "wings" and thereby strengthening her chest muscles.

The rich get richer, Pancho thought.

"So?" Amanda insisted. "Who's your fellow?"

"It's strictly business," Pancho said.

"Really? And what business would that be, dear?"

Pancho suppressed a sudden urge to sock Mandy in her smirking face.

"Lissen," she said, with some heat, "you go out just about every damned night, don't you? What's the matter with me havin' a date now and then?"

Mandy's expression softened. "Nothing, Pancho, really. I'm only curious, that's all. I think it's fine for you to have an enjoyable social life."

"Yeah, sure. You're just wonderin' who my date could be, 'cause you've got all the other men in Selene sewed up for yourself."

"Pancho, that's not true!"

"Like hell."

"I can't help it if men are attracted to me! I don't do anything to encourage them."

Pancho laughed out loud.

"Really I don't!"

"Mandy, all you have to do is breathe and the men swarm around you like flies on horseshit."

Amanda's cheeks flushed at Pancho's deliberate crudity. But then she smiled knowingly. "Well, it is rather fun to flirt. If men want to take me out to dinner,

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why not? I just bat my eyes at them and let them tell me how terrific they are."

"And then you bed down with 'em and everybody's happy."

Amanda flared with sudden anger. She started to reply, but stopped before saying a word. For several moments she stared down at her shoetops, then at last said in a lower voice, "Is that what you think?"

"It's the truth, ain't it?"

"Really, Pancho, I'm not a slut. I don't sleep with them, you know."

"You don't?"

"Well . . . once in a while. A great while."

Pancho looked at Amanda, really looked at her, and saw a very beautiful, very young woman trying to make her way in a world where a woman's physical appearance still categorized her in men's eyes. Jeez, she thought, Mandy prob'ly has to spend half her life keeping guys' hands off her. So she just smiles at them and jollies 'em along and splits before it gets serious. It's either that or carry a gun, I guess. Or a snake.

"Maybe we could ugly you up," Pancho muttered.

Amanda smiled ruefully. "That's what Mr. Randolph said."

"Huh? Randolph?"

"He told me that if I want to go on the mission with you, I'll have to stop making myself so attractive to the men that go with us."

Pancho nodded. "We've gotta find you some big, bulky sweatshirts. Or maybe keep you in a spacesuit the whole damn trip."

The two women laughed together. But after a few moments, Amanda asked again, "So tell me, Pancho, who's your boyfriend?"

Exasperated, Pancho snapped, "You want to meet him? Come on along tonight."

"Really? Do you mean it?"

"Sure, why not?" Pancho said. "I bet he'd like to meet you."

Pancho knew that Humphries would go ballistic over Mandy. Good. The man had been pressuring her to find out more about what Dan Randolph was up to. Humphries had been getting downright nasty about it.

Humphries had snarled at her when they'd had dinner, Pancho's first night back at Selene. The man had seemed cordial enough when he'd ushered her into that big, formal dining room in the house down at Selene's lowest level. But once he had started asking Pancho what information she had for him, and she had been forced to reply that she had little to report, his mood swiftly changed.

"That's it? That's all you've got to tell me?" Humphries had snarled.

With a helpless shrug, Pancho had answered, "He's had us cooped up in La Guaira, studyin' the fusion system."

"I'm paying you a small fortune and I'm not getting a damned bit of information from you! Nothing! A big, fat zero!"

It was a pretty dinky fortune, Pancho thought. Still, she had tried to placate the man. "But Mr. Humphries, other than the flight tests with that beat-up ol' cruise missile, he hasn't been *doin'* anything."

"He's been flitting all around the fucking world," Humphries had snapped, "from Kyoto to New York to Geneva to London. He's been talking to bankers and development agencies—even to the GEC, and he *hates* the GEC!"

Pancho had tried to be reasonable. "Look, I'm just a rocket jockey. He says he wants me to test-fly the fusion drive once it's built but it might be years before that happens."

"So what does he have you doing in the meantime?" Humphries demanded.

Pancho shrugged. "Nothin' much. He's sent me and Mandy here to Selene. His personal orders. We're supposed to be learnin' about the asteroids out in the Belt. He's got an astronomer from the Farside Observatory tutoring us."

Humphries' expression grew thoughtful. "Maybe he knows you're working for me. Maybe he's just put you on ice

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for the time being, until he figures out how to get rid of you."

Pancho didn't want Humphries to think about the possibility that she had told Randolph everything.

"Wouldn't it be easier for him just to fire me?" she suggested mildly.

"He's on his way here right now, you know," Humphries muttered.

"He is?" Pancho couldn't hide her surprise.

"You don't even know where he is?"

"I'm not on the mailing list for his personal itinerary," Pancho retorted.

"Now you listen to me, lady. *I* got your name to the top of Astro's personnel list so that Randolph would take you into this fusion rocket program of his. *I'm* the one who's gotten you promoted. I want results! I want to know when Randolph goes to the toilet, I want to know when he inhales and when he exhales."

"Then get yourself another spy," Pancho had said, trying to hold on to her swooping temper. "Whatever he's up to, he hasn't even been on the same continent with me most of the time. I only saw him that once, at the first flight test in Venezuela. You hired the wrong person, Mr. Humphries. You want somebody who can be his mistress, not a pilot."

Humphries had glared at her over the dinner table. "You're probably right," he had muttered. "Still . . . I want you on the job. It might take a while, but sooner or later he's going to use you to test-fly the fusion drive. That's when you'll become valuable to me. I just hired you too soon, that's all."

He made a forced little smile. "My mistake, I guess."

Puffing and sweating at the weight machine, Pancho thought, Yep, it's time for Humphries to meet Mandy. That might solve all my problems.

She laughed to herself. What a setup! Humphries sends Mandy after Randolph and she doesn't know that I've already told Randolph I'm supposed to be spyin' on him for the Humper. And Mandy would go for it, too; she'd love to have Randolph in her bed.

And meantime, she thought, I can be spyin' on Humphries for Randolph! Whatta they call that? I'll be a double agent. Yeah, that's it. A double agent. Terrific.

But what if Humphries drops me altogether once he sees Amanda? That's a possibility. Then you won't be any kind of an agent; you'll be out in the cold.

OK, so what? she told herself. So you won't be getting the extra money from Humphries, came the answer. So you'll have to maintain Sis on your Astro salary. Yeah, yeah, she argued back. I've been doin' that for years now, I can keep on doin' it.

Wait a minute, she said to herself. Humphries can't fire me. If he tried to, he'd be afraid that I'd tell Randolph everything. The Humper has to keep me on his payroll—or get rid of me altogether.

Pancho got off the weight machine and went to the exercise bike. Pedalling furiously, she thought, The trick is not to get fired by both Humphries *and* Randolph. I don't want to be left out in the cold. And I don't Humphries to start thinkin' he'd be better off if I happened to get myself killed. No sir!

MASTERSON AEROSPACE CORP.

"You can't see them, Mr. Randolph."

Dan was startled by Douglas Stavenger's words.

"I was staring, wasn't I?" he admitted.

Stavenger smiled patiently. "Most people do, when they first meet me. But the nanomachines are all safely inside me. You can't get infected by them."

The two men were sitting in Stavenger's spacious office, which looked more like a comfortable sitting room than a business center. Wide windows made up two of the room's walls. No desk, not even a computer screen in sight; only upholstered chairs and a small sofa off to one side of the room,

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with a few low tables scattered here and there. Dan had to remind himself that the windows were really transparent, not holoviews. They looked out on Selene's Grand Plaza, the only public greenspace within nearly half a million kilometers.

Douglas Stavenger's office was not buried deep underground. It was on the fifteenth floor of one of the three office towers that also served as supports for the huge dome that covered the Grand Plaza. Masterson Aerospace Corporation's offices took up the entire fifteenth floor of the tower.

Spread out beyond those windows was the six-hundred-meter-long Plaza itself, a grassy expanse with paved footpaths winding through it, flowered shrubbery and even small trees here and there. Dan could see people walking along the paths, stopping at the shopping arcades, playing lunar basketball in the big enclosed cage off by the orchestra shell. Kids were doing fantastically convoluted dives from the thirty-meter platform at one end of the Olympic-sized swimming pool, twisting and somersaulting in dreamlike slow motion before they splashed languidly into the water. A pair of tourists soared past the windows on brilliantly-colored plastic wings, flying like birds on their own muscle power in the low lunar gravity.

"It's a pleasant view, isn't it?" Stavenger said.

Dan nodded his agreement. While most people on the Moon instinctively wanted to live as deep underground as possible, Stavenger stayed up here, with nothing between him and the dangers of the surface except the reinforced lunar concrete of the Plaza's dome, and a meter or so of rubble from the regolith that had been strewn over it.

And why not? Dan thought. Stavenger and his family had more or less created the original Moonbase. They had fought a brief little war against the old United Nations to win their independence—and the right to use nanotechnology even though it had been banned on Earth.

Stavenger was filled with nanomachines. Turning his gaze back to him, Dan saw a good-looking young man apparently in his thirties smiling patiently at him. Stavenger wasn't much bigger than Dan, though he appeared more solidly built. Smooth olive complexion, sparkling blue eyes. Yet Douglas Stavenger was at least his own age, Dan knew, well into his sixties. His body was filled with nanomachines—tiny, virus-sized mechanisms that destroyed invading microbes, kept his skin smooth and young, took apart plaque and fatty deposits in his blood vessels atom by atom and flushed them out of his body.

The nanomachines apparently kept him youthful, as well. Far better than any of the rejuvenation therapies that Dan had investigated. There was only one drawback to the nanos: Douglas Stavenger was forbidden to return to Earth. Governments, churches, the media and the mindless masses feared that nanomachines might somehow get loose and cause unstoppable plagues or, worse, might be turned into new genocidal bioweapons.

So Stavenger was an exile who lived on the Moon, able to see the bright beckoning Earth hanging in the dark lunar sky but eternally prohibited from returning to the world of his birth.

He doesn't look upset about it, Dan thought, studying Stavenger's face.

"Whatever they've done for you," he said, "you look very healthy. And happy."

Stavenger laughed softly. "I suppose I'm the healthiest man in the solar system."

"I suppose you are. Too bad the rest of us can't have nanos injected into us."

"You can!" Stavenger blurted. Then he added, "But you wouldn't be able to go back Earthside."

Dan nodded. "We can't even use nanomachines to help rebuild the damage from the flooding and earthquakes.

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It's outlawed."

Stavenger hunched his shoulders in a slight shrug. "You can't blame them, really. More than ten billion people down there. How many maniacs and would-be dictators among them?"

"Too damned many," Dan mumbled.

"So you'll have to rebuild without nanotechnology, I'm afraid. They won't even allow us to sell them machinery built with nanos; they're frightened that the machinery is somehow infected by them."

"I know," said Dan. Selene built spacecraft of pure diamond out of piles of carbon soot, using nanomachines. But they were allowed no closer to Earth than the space stations in low orbit. Stupid, Dan said to himself. Nothing but ignorant superstition. Yet that was the law, everywhere on Earth.

It also made more jobs for people on Earth, he realized. The spacecraft that Astro used to fly from Earth's surface into orbit were all made basically the same way Henry Ford would have manufactured them; no nanotechnology allowed. Typical politician's thinking, Dan thought: bow to the loudest pressure group; keep outmoded industries alive and turn your back on the new opportunities. Even with the greenhouse warming wiping out half of Earth's industrial base, they still think the same old way.

Leaning back in his easy chair, Stavenger said, "I understand you're trying to raise the capital to develop a fusion drive."

Dan smiled crookedly at him. "You're well informed."

"It doesn't take a genius," Stavenger said. "You've had talks with Yamagata and most of the major banks."

"Plus the double-damned GEC."

Stavenger's brows rose slightly. "And now you're talking to me."

"That I am."

"What can I do for you, Mr. Randolph?"

"Dan."

"Dan, OK."

"You can help me save those ten billion people down there on Earth. They need all the help they can get."

Stavenger said nothing. He merely sat there, his face serious, waiting for Dan to go on.

"I want to open up the Asteroid Belt," Dan said. "I want to move as much of Earth's industrial base into orbit as we can, and we need the resources from the Belt to do that."

Stavenger sighed. "It's a pretty dream. I believed in it myself, once. But we found that it costs more than it's worth."

"Selene's sent spacecraft to the NEAs," Dan pointed out.

"Not for many years, Dan. It's just too expensive. We decided a long time ago that we can live on the resources that the Moon provides. We have to. No asteroids."

"But with fusion, it becomes economically feasible to extract resources from the NEAs. And even the Belt."

"Are you certain of that?" Stavenger asked softly.

"Positively," Dan agreed. "Same situation as the Clipperships. Your Clipperships brought down the cost of going into orbit to the point where it became economically feasible to build space stations and solar power satellites and full-scale factories."

"They're not *my* Clipperships, Dan."

"Masterson Corporation is your family's outfit, isn't it?"

Stavenger shifted uneasily in his chair, his smile fading. "Masterson was founded by my family, true enough. I still own a big slice of its stock, but I'm only the Chairman Emeritus. I'm not really involved in the company's operations any longer."

"But they still listen to you."

The smile returned, but it was more guarded now. "Sometimes," Stavenger said.

"So how would Masterson like to come in with me on this fusion system? It'll be a gold mine."

Stavenger hesitated before replying,

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"I've been told that Humphries Space Systems is backing your fusion program."

"Martin Humphries has offered to, that's true," Dan admitted.

"But you're not satisfied with his offer?"

"I don't know if I can trust him. He comes waltzing into my office and drops this fusion deal in my lap. Why? Why didn't he do it for himself? What's he want me for?"

"Maybe it's Astro Manufacturing that he wants," Stavenger said.

Dan nodded vigorously. "Yep, that's what scares me. The man has a reputation for being a grabber. He's built Humphries Space Systems by swallowing up other companies."

Again Stavenger hesitated. At last he said, "He's on the verge of acquiring a majority of Masterson's stock."

"What?" A jolt of surprise flashed through Dan.

"I'm not supposed to know, really," Stavenger said. "It's all been very hush-hush. Humphries is on the verge of buying out two of our biggest shareholders. If he's successful, he'll have enough clout to load the board of directors with his own people."

"Damn," grumbled Dan. "Double dammit to hell and back."

"I'm afraid you'll have to play with Humphries whether you like it or not. In his court."

Suppressing an urge to get up and pound on the walls, Dan heard himself say, "Maybe not."

"No?"

"There's one other possibility."

"And what might that be?" Stavenger was smiling again, as if he knew precisely where Dan was heading.

"Selene."

"Ahh," said Stavenger, leaning back in his cushioned chair. "I thought so."

"Selene has trained technical personnel and manufacturing facilities. I could bring my fusion people up here and we could build the prototype together."

"Dan," said Stavenger gently, "who would pay Selene's technical personnel? Who would pay for using our facilities?"

"We could share the cost. I can divest a couple of Astro's operations and raise some cash that way. Selene could donate—"

The expression on Stavenger's face stopped him. It reminded Dan of the look that his geometry teacher would give him, back in high school, when he went off on the wrong tangent.

"You know something that I don't," Dan said.

Stavenger laughed gently. "Not really. You know it, too, but you're not thinking of it. You're overlooking the obvious."

Dan blinked, puzzled.

"You are staring at the solution to your problem," Stavenger prompted.

"I'm looking at you and you say that I'm—" The light finally dawned in Dan's mind. "Oh for my sweet old Aunt Sadie! Nanomachines."

Stavenger nodded. "Nanotechnology can build your fusion engine for you, and do it faster and cheaper than the orthodox way."

"Nanotechnology," Dan repeated.

"It would mean your spacecraft could never get any closer to Earth than low orbit."

"So what?" Dan exclaimed. "The double-damned ship is for deep-space operations. It'll never touch down on Earth or any other planetary surface."

"Then you should have no problem," said Stavenger.

"You mean Selene will back us?"

Very carefully, Stavenger replied, "I believe the governing council will allocate personnel and facilities to demonstrate that a prototype fusion engine can be built by using nanotechnology."

Dan grinned widely. "Yep, and once the prototype proves out, Selene will have a major new product line to manufacture: fusion drives."

"And access to the asteroids."

"Damned right! And any comets that

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come waltzing by, too."

"Selene and Astro Manufacturing will be partners," Stavenger said.

"Partners!" Dan agreed, sticking out his hand. Stavenger gripped it firmly and they shook on the deal.

THE CATACOMBS

It had started as a temporary storage section, just off Selene's small hospital, up by the main airlock and the garage that housed the tractors and other equipment for work on the surface.

Bodies were stored along the blank corridor walls, sealed into protective metal canisters to await transport back to Earth. In earlier days, most of the people who died on the Moon were workers killed in accidents or visitors who made fatal mistakes while outside on the surface. Hardly anyone died of natural causes until later, when people began settling at Selene to live out their lives.

So the bodies awaiting shipment back Earthside were stored in the corridor between the hospital and the garage, convenient to the tunnel that led to the spaceport.

Eventually, of course, people who had spent their lives on the Moon wanted to be buried there, usually in the farms that provided food and fresh oxygen for the community. But often enough, families back Earthside demanded the bodies of their deceased loved ones, despite the deceased's wishes. Some legal wrangles took years to unravel. So the bodies were put into metal dewars filled with liquid nitrogen, frozen solid at cryogenic temperature while the lawyers argued and ran up their fees.

It took several years for Selene's governing council to realize that a new trend had started. Cryonics. People were coming to Selene to be declared legally dead, then frozen into suspended animation in the hope that they could one day be cured of the disease that killed them, thawed, and returned to life once more.

Cryonics had been banned in most of the Earth's nations. The faithful of many religions considered it an affront to God, an attempt to evade the divinely-mandated limits on human lifespan. While rejuvenation therapies could be done in relative secrecy, having one's body preserved cryonically was difficult to hide. With global warming causing catastrophes all over the world, with many nations barely able to feed their populations, attempts to forestall death and elongate lifespan were frowned upon, if not banned altogether.

So those who wanted to avoid death, and had the money to reach the Moon, came to Selene for their final years, or months, or days. Thus the catacombs grew, row upon row of gleaming stainless steel dewars, each filled with liquid nitrogen, each holding a human body that one day might be revived.

Pancho Lane had brought her sister to Selene, back when the teenager had been diagnosed with an inoperable brain tumor. Sis was losing her memory, losing control of her body functions, losing her ability to speak or smile or even think. Pancho had brought her to Selene, had given Sis the final injection herself, had watched her younger sister's inert unmoving body being slid into the cold bloodless canister, watched the medical team seal the dewar and begin the long, intricate freezing process, her tears mingling with the cold white mist emanating ghostlike from the hoses.

Six years ago, Pancho thought as she walked slowly along the quiet corridor, looking for her sister's name on the long rows of metal cylinders resting along the blank stone walls.

She had heard rumors that a few people had actually been revived from cryonic immersion, thawed back to life. And other rumors, darker, that claimed those revived had no memories, no minds at all. They were like blank-brained newborns; they even had to be toilet trained all over again.

Doesn't matter, Pancho said to herself

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as she stopped in front of Sis's dewar. I'll raise you all over again. I'll teach you to walk and talk and laugh and sing. I will, Sis. No matter how long it takes. No matter what it costs. As long as I'm alive, you're not going to die.

She stared at the small metal nameplate on the dewar's endcap. SUSAN LANE. That's all it said. There was a barcode next to her name, all Sis's vital information in computer-readable form. Not much to show for a human lifetime, even if it was only seventeen years.

Her wristwatch buzzed annoyingly. Brushing at the tears in her eyes, she saw that the watch was telling her she had one hour to get cleaned up and dressed and down to Humphries' place.

With Amanda.

Mandy wore virginal white, a sleeveless mandarin-collared dress with a midthigh skirt that clung lovingly to her curves. She'd done her hair up in the latest piled-high fashion: some stylist's idea of neoclassical. Pancho had put on her best pantsuit, pearl gray with electric blue trim, almost the same shade of blue as Elly. Next to Amanda, though, she felt like a walking corpse.

She'd phoned Humphries several times to tell him she was bringing Amanda, and gotten the answering machine each time. It wasn't until she'd been on her way to the catacombs that Humphries had returned her calls, angrily demanding to know who this Amanda Cunningham was and why Pancho wanted to bring her to their meeting.

It was tough holding a reasonable conversation into the wristphone, but Pancho finally got across the information that Amanda was going to be her copilot on the mission and she'd thought he might be interested in recruiting her to help Pancho's espionage work.

In the wristphone's tiny screen it was almost impossible to judge the expression on Humphries' face, but his tone was clear enough.

"All right," he said grudgingly. "Bring her along if you think she might be able to help us. No sweat."

Pancho smiled sweetly and thanked him and clicked the phone off. No sweat, huh? she thought, laughing inwardly. He'll change his mind once he gets a look at Mandy. He'll sweat plenty.

Pancho spent the time on the electric stairways to Selene's lowest level telling Mandy everything she knew about Humphries. Everything except the fact that he'd hired her to spy on Dan Randolph.

"He's actually a billionaire?" Amanda's big blue eyes went wider than ever when Pancho described Humphries' underground palace.

"Humphries Biotech," Pancho replied. "The Humphries Trust, lord knows what else. You can look him up in the financial nets."

"And you're dating him!"

Frowning slightly at her incredulousness, Pancho replied, "I told you, it's strictly business. He's . . . eh, he's tryin' to hire me away from Astro."

"Really?" That suspicious, supercilious tone dripped from the word.

Pancho grinned at her. "More or less."

Once they stepped through the airlock-type door and into Humphries' underground garden, Amanda gasped with awe. "It's heavenly!"

"Pretty neat," Pancho agreed.

Humphries was standing at the open door to the house, waiting for them, eyeing Amanda as they came up the walk.

"Martin Humphries," Pancho said, as close to a formal introduction as she knew, "I would like you to meet—"

"Ms. Amanda Cunningham," Humphries said, all smiles. "I looked up your dossier when I got Pancho's message that you were joining us this evening."

Pancho nodded, impressed. Humphries can tap into Astro's personnel files. He must have Dan's offices honeycombed with snoops.

Humphries took Amanda's extended

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hand and bent over it, his lips barely touching her satiny white skin. Amanda looked as if she wanted to faint.

"Come in, ladies," Humphries said, tucking Amanda's arm under his own. "Come in and welcome."

To Pancho's surprise, Humphries didn't come on to Amanda. Not obviously, at least. A human butler served aperitifs in the library-cum-bar and Humphries showed off his collection of first editions.

"Pretty rare, some of them," he boasted mildly. "I keep them here because of the climate control system. Back home in Connecticut it would cost a considerable sum to keep the old family home at a constant temperature and humidity. Here in Selene it comes automatically."

"Or we breathe vacuum," Pancho commented. Amanda gave her a knowing look.

The butler showed them to the dining room, where the women sat on either side of Humphries. A pair of squat, flat-topped robots trundled back and forth from the kitchen carrying plates and glasses. Pancho watched intently as the robots' padded claws gripped the chinaware and crystal. They didn't drop a thing, although while clearing the salad plates, one of them missed Pancho's dish by a fraction of a millimeter and almost knocked it off the table. Before anyone could react, though, it recovered, grasped the plate firmly and tucked it into its recessed storage section.

"That's a pretty good optical recognition system they've got," Pancho said.

"I don't believe it's optical," Amanda countered. To Humphries she asked, "Is it?"

"Very sharp, Amanda," he said, impressed. "Very sharp. The dishes have monomolecular beacons sprayed on their bottoms. The robots sense the microwave signals."

Pancho lifted up her water tumbler and squinted at its bottom.

"The chip's too small to see with the naked eye," Humphries said.

"What powers 'em?"

"The heat from the food or drink. They have trouble with iced drinks . . . and your salad."

Pancho thought it over for half a second. "Dishes pick up residual heat when we handle them, huh?"

"That's right."

Pancho smiled as the other robot placed a steaming plate of frogs' legs before her. Don't want Humphries to think Mandy's the only smart one here, she told herself.

All through dinner Humphries was charming, solicitous, all smiles. He paid almost as much attention to Pancho as he did to Amanda, up to the point where he encouraged Mandy to tell them about her early life. She began to talk, hesitantly at first, about growing up in London, winning a scholarship to the International Space University.

"It wasn't easy," Amanda said, with almost childlike candor. "All the men seemed to think I was better suited to be a photographer's model than an astronaut."

Humphries made a sympathetic murmur. Pancho nodded, understanding all over again that Mandy's good looks had been as much of a problem for her as an advantage.

"But I made it," she finished happily, "and here we all are."

"Good for you," said Humphries, patting her hand. "I think you've done wonderfully well."

As dessert was being served—fresh fruit from the botanical garden outside with soymilk ice cream—Amanda asked where the lavatory was.

Once she had left the room Pancho leaned closer to Humphries and asked in a lowered voice, "Well, whattaya think?"

He frowned with annoyance. "About what?"

"About Mandy." She almost added, *Lunkhead*, but stopped herself just in time.

"She's wonderful," Humphries said,

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beaming. "Beautiful but brainy, too. You don't see that very often."

Pancho thought, Women don't let you see their brains very often, not if they can get by on their looks.

Aloud, she asked, "So d'you think she'd be any good cozyin' up to Dan Randolph?"

"No!" he snapped.

"No?" Pancho was astonished. "Why not?"

"I don't want her anywhere near Randolph. He'll seduce her in a hot second."

Pancho stared at the man. I thought that was the whole idea, she said to herself. Get Mandy into Randolph's bed. I thought that's what he'd want.

"She's much too fine a woman to be used that way," Humphries added.

Oh, for cryin' out loud, Pancho realized. He's fallen for her! This guy who picks up women like paperclips and dumps 'em when he feels like it, he doesn't just have the hots for Mandy. He's fallen in love with her. Just like that!

SELENE GOVERNING COUNCIL

The meeting took place in Selene's theater, with the council sitting at student's desks arranged up on the stage in a semicircle. Just about every seat on the main floor and the balconies was taken, although the box seats on either side of the stage were all empty. Maybe they've been roped off for some reason, Dan thought. Must be two thousand people out there, he thought as he peeked out at the audience through the curtains screening the stage's wings. Just about every voting citizen in Selene has showed up for this meeting.

As he stood in the wing of the stage, the council members filed past him, taking their seats. For the most part they looked young and vigorous. Six women, five men, none with white hair. A couple of premature baldies among the men; they must be engineers, Dan thought. He knew that membership on the council was a part-time task assigned by lottery; no one was allowed to duck their public service, although they could take time off their regular jobs to attend to their extra duties.

"Nervous?"

Dan turned at the sound of Doug Stavenger's voice.

Smiling, he answered, "When you've had to sit through as many board meetings as I have, you don't get nervous, you just want to get it the hell over with."

Stavenger patted Dan lightly on the shoulder. "This one will be different from all the others, Dan. It's more like an old-fashioned New England town meeting than one of your board of directors' get-togethers."

Dan agreed with a brief nod. Often in his mind he'd spelled it b-o-r-e-d meeting. This one would be different, he felt sure.

It was.

Stavenger served as non-voting chairman of the governing council, a largely honorary position. More pomp than circumstance, Dan thought. The chairman stood at the podium set up at one end of the stage, only a few meters from where Dan stood waiting for his turn to speak. The meeting agenda was displayed on a wallscreen along the back of the stage. Dan was dismayed to see that he was last on a list of nine.

The first five items went fairly quickly. The sixth was a new regulation tightening everyone's water allotment. Several people from the audience shot to their feet to make their opinions heard in no uncertain terms.

One of the council members was chairman of the water board, a chubby, balding, red-faced man wearing the coral-red coveralls of the Tourism Department. The student's desk at which he sat looked uncomfortably small for him.

"There's no way around it," he said, looking flustered. "No matter how efficiently we recycle our water, it's not a hundred percent and it never will be. The more people we allow in, the less

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water we have to go around."

"Then why don't we shut down tourism," came an angry voice from the floor.

"Tourism's down to a trickle anyway," the water chairman replied. "It's less than five percent of our problem. Immigration is our big difficulty."

"Refugees," someone said in a harsh stage whisper.

"Don't let 'em in!" an angry voice snapped.

"You can't do that!"

"Why the hell not? They made the mess on Earth. Let 'em stew in their own crap."

"Can't we find new sources of water?" a citizen asked.

Stavenger answered from the podium, "Our exploration teams have failed to locate any other than the polar ice fields we've been using all along."

"Bring up a few loads from Earthside," someone suggested.

"Yeah, and they'll gouge us for it."

"But if we need it, what else can we do?"

The audience stirred restlessly. A dozen conversations buzzed through the theater.

The water board chairman raised his voice to be heard over the chatter. "We're negotiating with the GEC for water shipments, but they want to put one of their own people onto the water board, in return."

"Hell no!"

"Never!"

"Those bastards have been trying to get control of us since day one!"

The audience roared its angry disapproval.

Stavenger, still standing at the podium, pressed his thumb on a button set into its control panel and a painfully loud hooting whistle rang through the theater, silencing the shouters. Dan covered his ears until the shriek died away.

"We've got to maintain order here," Stavenger said in the numbed silence. "Otherwise we'll never get anywhere."

Reluctantly, they accepted the fact that water allotments would be decreased slightly. Then the water board chairman held out a potential carrot.

"We'll have the new recycling system on-line in a few months," he said, drumming his fingers nervously on his desktop. "If it works as efficiently as the simulations show it should, we can go back to the current water allotments—at least for a year or so."

"And what happens if this recycling system fails?" asked a stern-faced elderly woman.

"It's being thoroughly tested," the water chairman answered defensively.

"This is just a way for the people running the damned hotel to put up their own swimming pool and spa," grumbled a lanky, longhaired citizen. He looked like a physicist to Dan. "Tourism is down so they want to fancy up the hotel to attract more tourists."

Dan wondered about that. Tourism is down because the world's going down the toilet, he thought. Then he admitted, But, yeah, people running tourist facilities will try their damnedest to attract customers, no matter what. What else can they do, except go out of business altogether?

In the end, the council decided to accept the water allotment restrictions until the new recycling system had been in operation for three continuous months. Then they would have a new hearing to decide whether they could return to the old allotments.

Two more items were swiftly disposed of, then at last Stavenger said, "The final item on our agenda tonight is a proposal by Dan Randolph, head of Astro Manufacturing." He turned slightly and prompted, "Dan?"

There was some scattered applause as Dan stepped up to the podium. Astro employees, Dan thought. Stavenger moved off-stage.

He gripped the edges of the podium and looked over the crowd. He had no notes, no visual aids. For several mo-

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ments he merely stood there, thinking hard. The audience began to murmur, whisper.

Dan began, "Halley's Comet will be returning to the inner solar system in a few years. Last time it came by, Halley's blew out roughly thirty million tons of water vapor in six months. If I remember the numbers right, the comet lost something like three tons of water per second when it was closest to the Sun."

He waited a heartbeat, then asked, "Do you think you could use that water?"

"Hell yes!" somebody shouted. Dan grinned when he saw that it was Pancho Lane, sitting up in the first row of the balcony.

"Then let's go get it!" Dan said.

He spent the next fifteen minutes outlining the fusion rocket system and assuring them that it had performed flawlessly in all its tests to date.

"A fusion-driven spacecraft can bring in all the water you need, either from hydrate-bearing asteroids or from comets," Dan said. "I need your help to build a full-scale system and flight-test it."

One of the women councilors asked, "Are you asking Selene to fund your corporation? Why can't you raise the money from the regular sources?"

Dan made himself smile at her. "This project will cost between one and two billion international dollars, Earthside. None of the banks or other funding sources that I've approached will risk that kind of money. They're all fully committed to rebuilding and mitigation programs. They've got their hands full with the greenhouse warming, they're not interested in space projects."

"Damned flatland idiots," somebody groused.

"I agree," Dan said, grinning. "They're too busy doing what's urgent to even think about what's important."

"Out of all the corporations on Earth," someone called out, "surely you can make a deal or two to raise the capital you need."

Dan decided to cut the discussion short. "Listen. I could probably put together a deal that would raise the money we need, but I thought I'd give you a chance to come in on this. It's the opportunity you've been waiting for."

"Selene doesn't have that kind of money at its disposal," said one of the councilmen.

"No," countered Dan, "but you have the trained people and the facilities to build the fusion rocket with nanomachines."

A hush fell over the theater. Nanotechnology. They all knew it was possible. And yet . . .

"Nanomachines aren't magic wands, Mr. Randolph," said the councilor seated closest to Dan, a lean, pinch-faced young man who looked like a jogging fanatic.

"I understand that," said Dan.

"At one time we thought we could develop nanomachines to produce water for us by taking hydrogen from the incoming solar wind and combining it with oxygen from the regolith. It was technically feasible but in practice a complete failure."

Recognizing the councilman as one who loved the sound of his own voice, Dan said curtly, "If nanomachines can build entire Clipperships, they can build fusion drives."

Another woman councilor, with the bright red hair and porcelain-white complexion of Ireland, spoke up. "I've been stuck with the job of treasurer for the council, the thanks I get for being an honest accountant."

Dan laughed, along with most of the audience.

"But it's a sad fact that we don't have the funds to spare on your program, Mr. Randolph, no matter how admirable it may be. The money just isn't in our hands."

"I don't want money," Dan said.

"Then what?"

"I want volunteers. I need people

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who are willing to devote their time to the greatest challenge of our age: developing the resources of the entire solar system."

"Ah, but that boils down to money, now, doesn't it?"

"No it doesn't," said a deep voice from the middle of the theater. Dan saw a squat, heavily-built black man get to his feet.

"I'm Bernie James. I retired from the nanotech lab last year. I'm only a technician, but I'll work with you on this."

A few rows farther back, a taller man, blond hair cropped short, got to his feet. "Rolf Uhrquest, Space Transportation Department," he said, in a clear tenor voice. "I would be willing to take my accumulated vacation time to work on this fusion project."

Dan smiled at them both. "Thank you."

"And I believe," Uhrquest continued, "that Dr. Cardenas would be interested also." Turning slightly, he called, "Dr. Cardenas, are you here?"

No one answered.

"I will find her," Uhrquest said, very seriously. "It is a shame she is not present today."

Dan looked expectantly out at the audience, but no one else stood up. At last he said, "Thank you," and stepped away from the podium, back into the wings of the stage. Stavenger gave him a quick thumbs-up signal and returned to the podium for the final item on the meeting's agenda: a request from a retired couple to enlarge their living quarters so they could have enough space to start a new business for themselves.

Once the meeting broke up, Stavenger said, "If Kris Cardenas had been anywhere in Selene I would have introduced you to her. Unfortunately, she's in a space station in near-Earth orbit, working on developing nanomachines to bring down the costs of the Mars exploration centers."

"Which station?" Dan asked.

"The one over South America."

Dan grinned at him. "*Nueva Venezuela*. I helped build that sucker. Maybe it's time for me to pay a visit there."

ALPHONSUS

Pancho watched the safety demonstration very carefully. No matter that she had put on a spacesuit and done EVA work dozens of times, she paid patient attention to every word of the demo. This was going to be on the surface of the Moon, and the differences between orbital EVAs and a moonwalk were enough to worry about.

The tourists in the bus didn't seem to give a damn. Hell, Pancho thought, if they're stinky-rich enough to afford a vacation jaunt to the Moon, they must have the attitude that nothing bad'll happen to them, and if it does, they'll get their lawyers to sue the hell out of everybody between here and Mars.

They had all suited up in the garage at Selene before getting onto the bus. It was easier that way; the bus was way too tight for fourteen tourists to wriggle and squeeze into their spacesuits. They rode out to the Ranger 9 site in the hard-shell suits, their helmets in their laps.

After all these years, Pancho thought, they still haven't come up with anything better than these hard-shell suits. The science guys keep talking about softsuits and even nanomachine skins, but it's still nothing more'n talk.

Even the teenagers went quiet once they cleared the garage airlock and drove out onto the cracked, pock-marked surface of Alphonsus. A hundred and eight kilometers across, the crater floor went clear over the horizon. The ringwall mountains looked old and weary, slumped smooth from eons of being sandpapered by the constant infall of meteoric dust.

It was the dust that worried Pancho. In orbital space you were floating in vacuum. On the surface of the Moon you had to walk on the powdery regolith, sort of like walking on beach sand. Ex-

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cept that the "sand" billowed up and covered your boots with fine gray dust. Not just your boots, either, Pancho reminded herself. She'd heard tales about lunar dust getting into a suit's joints and even into the life-support backpack. The dust was electrostatically charged from the incoming solar wind, too, and this made the freaking stuff cling like mad. If it got on your visor it could blind you; try to wipe it off with your gloves and you just smeared it worse.

They'd had some trouble finding Pancho a suit that would fit her comfortably; in the end they had to break out a brand new one, sized long. It smelled new, like pristine plastic. When the bus stopped and the guide told the tourists to put on their helmets, Pancho sort of missed the familiar scents of old sweat and machine oil that permeated the working suits she'd worn. Even the air blowing gently across her face tasted new, unused.

The tour guide and the bus driver both checked out each tourist before they let the visitors climb down from the bus's hatch onto the lunar regolith. Pancho's helmet earphones filled with "oohs" and "lookit that!" as, one by one, the tourists stepped onto the ancient ground and kicked up puffs of dust that lingered lazily in the gentle gravity of the Moon.

"Look how bright my footprints are!" someone shouted excitedly.

The guide explained, "That's because the topmost layer of the ground has been darkened by billions of years of exposure to hard radiation from the Sun and deep space. Your bootprints show the true color of the regolith underneath. Give 'em a few million years, though, and the prints will turn dark, too."

For all the years she'd worked in space, Pancho had never been out on a Moonwalk. She found it fascinating, once she cut off the radio frequency that carried the tourists' inane chatter and listened only to the prerecorded talk that guided visitors to the Ranger 9 site.

To outward appearances, she was just another tourist from one of the three busloads that were being shepherded along the precisely marked paths on the immense floor of Alphonsus. But Pancho knew that Martin Humphries was in one of the other buses, and her reason for being here was to report to him, not to sightsee.

She let the cluster of tourists move on ahead of her while she lingered near the parked busses. The canned tourguide explanation was telling her about the rilles that meandered near the site of the old spacecraft crash: sinuous cracks in the crater floor that sometimes vented out thin, ghostlike clouds of ammonia and methane.

"One of the reasons for locating the original Moonbase in Alphonsus' ringwall mountains was the hope of utilizing these volatiles for—"

She saw Humphries shuffling toward her, kicking up clouds of dust as if it didn't matter. It had to be him, she thought, because his spacesuit was different from the ones issued to the tourists. Not different enough to be obvious to the tenderfeet, but Pancho recognized the slightly wider, heavier build of the suit and the tiny servo motors at the joints that helped the wearer move the more massive arms and legs. Extra armor, she thought. He must worry about radiation up here.

Humphries had no name tag plastered to the torso of his suit, and until he was close enough to touch helmets she could not see into his heavily-tinted visor to identify his face. But he walked right up to her, kicking up the dust, until he almost bumped his helmet against hers. She recognized his features through the visor: round and snubby-nosed, like some freckle-faced kid, but with those cold, hard eyes peering at her.

Pancho lifted her left wrist and poised her right hand over the comm keyboard, asking Humphries in pantomime

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which radio frequency he wanted to use. He held up a gloved hand and she saw that he was holding a coiled wire in it. Slowly, with the deliberate care of a person who was not accustomed to working in a spacesuit, he fitted one end of the wire into the receptacle built into the side of his helmet. He held out the other end. Pancho took it and plugged into her own helmet.

"OK," she heard Humphries' voice, almost as clearly as if they were in a comfortable room, "now we can talk without anyone tapping into our conversation."

Pancho remembered her childhood, when she and some of the neighborhood kids would create telephone links out of old paper cups and lengths of waxed string. They were using the same principle, linking their helmets with the wire so they could converse without using their suit radios. This'll work, Pancho thought, as long as we don't move too far apart. She judged the wire connecting their helmets to be no more than three meters long.

"You worried about eavesdroppers?" she asked Humphries.

"Not especially, but why take a chance you don't have to?"

That made sense, a little. "Why couldn't we meet down at your place, like usual?"

"Because it's not a good idea for you to be seen going down there so often, that's why," Humphries replied testily. "How long do you think it would be before Dan Randolph finds out you're coming to my residence on a regular basis?"

Teasingly, Pancho said, "So he finds out. He'll just think you're inviting me to dinner."

Humphries grunted. Pancho knew that he had invited Amanda to dinner at his home twice since they'd first met. And he'd stopped asking Pancho to report to him down there. Now they met at prearranged times and places: strolling in the Grand Plaza, watching low-gravity ballet in the theater, doing a tourist Moonwalk on the crater floor.

Pancho would have shrugged if she hadn't been encased in the suit. She said to Humphries, "Dan made his pitch to the governing council."

"I know. And they turned him down."

"Well, sort of."

"What do you mean?" he snapped.

"A couple of citizens volunteered to work on Dan's project. He's goin' down to the Venezuela space station to try to get Dr. Cardenas to head up the team."

"Cardenas?"

"She's the top expert at nanotech," Pancho said.

"They gave her the Nobel Prize," Humphries muttered, "before nanotechnology was banned on Earth."

"That's the one he's gonna talk to."

For several long moments Humphries simply stood there unmoving, not speaking a word. Pancho thought he looked like a statue, with the spacesuit and all.

At length he said, "He wants to use nanomachines to build the rocket. I hadn't expected that."

"It's cheaper. Prob'ly better, too."

She sensed Humphries nodding inside his helmet. "I should've seen it coming. If he can build the system with nanos, he won't need my financing. The sonofabitch can leave me out in the cold—after I gave him the fusion idea on a silver fucking platter!"

"I don't think he'd do that."

"Wouldn't he?" Humphries was becoming more enraged with every word. "I bring the fusion project to him, I offer to fund the work, but instead he sneaks behind my back to try to raise funding from any other source he can find. And now he's got a way to build the fucking rocket without me altogether! He's trying to cut my balls off!"

"But—"

"Shut up, you stupid bitch! I don't care what you think! That prick bastard Randolph thinks he can screw me out of this! Well, he's got another thing coming! I'll break his back! I'll *destroy* the

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sonofabitch!"

Humphries yanked the wire out of Pancho's helmet, then pulled the other end out of his own. He turned and strode back to the bus that had carried him out to the Ranger 9 site, practically boiling up a dust storm with his angry stomping. If he hadn't been in the heavy spacesuit, Pancho thought, he'd hop two meters off the ground with each step. Prob'ly fall flat on his face.

She watched as he gestured furiously to the bus driver, then clambered aboard the tourist bus. The driver got in after him, closed the hatch, and started off for the garage back at Selene.

Pancho wondered if Humphries would allow the driver to come back out and pick up the other tourists, or would he leave them stranded out here? Well, she thought, they can always squeeze into the other buses.

She decided there was nothing she could do about it, so she might as well enjoy what was left of her outing. As she walked off toward the wreckage of the tiny, primitive Ranger 9, though, she thought that she'd better tell Dan Randolph about this pretty damned quick. Humphries was sore enough to commit murder, it seemed to her.

SPACE STATION *NUEVA VENEZUELA*

It was almost like coming home for Dan. *Nueva Venezuela* had been one of the first big projects for the fledgling Astro Manufacturing Corp., back in the days when Dan had moved his corporate headquarters from Texas to La Guaira and married the daughter of the future president of Venezuela.

The space station had lasted much better than the marriage. Still, the station was old and scuffed up. As the transfer craft from Selene made its approach, Dan saw that the metal skin of her outer hulls was dulled and pitted from long years of exposure to radiation and mite-sized meteoroids. Here and there bright new sections showed where the maintenance crews were replacing the tired, eroded skin. A facelift, Dan thought, smiling. Well, she's old enough to need it. They're probably using cermet panels instead of the aluminum we started with. Lighter, tougher, maybe even cheaper if you consider the length of time they'll last before they need replacing.

Nueva Venezuela was built of a series of concentric rings, nested within one another. The outermost ring spun at a rate that gave the occupants inside it a feeling of normal Earthly gravity. The two other rings were placed where they would simulate Mars' one-third *g* and the Moon's one-sixth. The docking port at the station's center was effectively at zero gravity. The tech guys called it microgravity, but Dan always thought of it as zero *g*.

A great place to make love, Dan remembered. Then he chuckled to himself. Once you get over the heaves. Nearly everybody got nauseous their first few hours in weightlessness.

Dan went through customs swiftly, allowing the inspector to rummage through his one travelbag while he tried to keep himself from making any sudden movements. He could feel his sinuses starting to puff up as the liquids in his body shifted in response to weightlessness. No postnasal drips in zero *g*, Dan told himself. But you sure can get a beaut of a headache while the fluids build up in your sinuses before you adapt.

The main thing was to make as few head motions as possible. Dan had seen people suddenly erupt with projectile vomiting from merely turning their heads or nodding.

The inspector passed him easily enough and Dan gratefully made his way along the tube corridor that led "down" to the lunar-level wheel.

He dumped his bag in the cubbyhole compartment he'd rented for this visit, then prowled along the sloping corridor that ran through the center of the wheel, checking the numbers on each

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door.

Dr. Kristine Cardenas' name was neatly printed on a piece of tape stuck above her door number. Dan rapped once, and opened the door.

It was a small office, hardly enough room for the desk and the two plain plastic chairs in front of it. A good-looking young woman sat at the desk: shoulder-length sandy hair, cornflower blue eyes, broad swimmer's shoulders. She wore an unadorned jumpsuit of pastel yellow; or maybe it had once been brighter, but had faded after many washings.

"I'm looking for Dr. Cardenas," said Dan. "She's expecting me. I'm Dan Randolph."

The young woman smiled up at him and extended her hand. "I'm Kris Cardenas."

Dan blinked. "You . . . you're much too young to be *the* Dr. Cardenas."

She laughed. Motioning Dan to one of the chairs in front of the desk, she said, "I assure you, Mr. Randolph, that I am indeed *the* Dr. Cardenas."

Dan looked into those bright blue eyes. "You too, huh? Nanomachines."

She pursed her lips, then admitted, "It was a temptation I couldn't resist. Besides, what better way to test what nanotechnology can do than to try it on yourself?"

"Like Pasteur injecting himself with the polio vaccine," Dan said.

She gave him a sidelong look. "Your grasp of the history of science is a bit off, but you've got the basic idea."

Dan leaned back in the plastic chair. It creaked a little but accommodated itself to his weight. "Maybe I ought to try them, too," he said.

"If you don't have any plans to return to Earth," Cardenas replied, with a sudden sharpness in her voice.

Dan changed the subject. "I understand you're working with the Mars exploration program."

She nodded. "Their budget's being slashed to the bone. Beyond the bone, actually. If we can't develop nanos to take over the life-support functions at their bases, they'll have to close up shop and return to Earth."

"But if they use nanomachines they won't be allowed to come back home."

"Only if they use nanomachines in their own bodies," Cardenas said, raising a finger to emphasize her point. "The IAA had graciously decided they can be allowed to use nanotechnology to maintain and repair their equipment."

Dan caught the sarcasm in her tone. "I'll bet the New Morality was thrilled with that decision."

"They don't run the entire show. At least, not yet."

Dan huffed. "Good reason to live off Earth. I've always said, When the going gets tough, the tough get going—"

"—to where the going's easier," Cardenas finished for him. "Yes, I've heard that."

"I don't think I'd be able to live off-Earth forever," Dan said. "I mean . . . well, that's home."

"Not for me," Cardenas snapped. "Not for half a dozen of the Martian explorers, either. They've accepted nanomachines. They have no intention of returning to Earth."

Surprised, Dan said, "I didn't know that."

"There hasn't been much publicity about it. The New Morality and their ilk have a pretty tight grip on the news media."

Dan studied her face for a long, silent moment. Dr. Cardenas was physically youthful, quite attractive, a Nobel laureate, the leader in her chosen field of study. Yet she seemed so bitter.

"Well, anyway," he said, "I'm grateful that you've taken the time to see me. I know you're busy."

She broke into a pleased smile. "Your message seemed kind of . . ." she fished for a word, ". . . mysterious. It made me wonder why you wanted to see me in person, rather than by phone."

Dan grinned back at her. "I've found

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that it's always easier to discuss matters face-to-face. Phones, mail, even VR meetings can't replace person-to-person contact."

Cardenas' smile turned knowing. "It's more difficult for someone to say 'no' to your face."

"You got me," Dan replied, raising his hands in mock surrender. "I need your help and I didn't want to tell you about it long-distance."

She seemed to relax somewhat. Easing back in her chair, she asked, "So what's so important that you came up here to see me?"

"Down here. I came in from Selene."

"What's your problem? I've been so wrapped up with this Mars work that I haven't been keeping up with current events."

Dan took in a breath, then started, "You know I'm the head of Astro Manufacturing."

Cardenas nodded.

"I've got a small team ready to build a prototype fusion rocket, using nanomachines."

"A fusion rocket?"

"We've tested small models. The system works. Now we need to build a full-scale prototype and test it. We're planning a mission to the Asteroid Belt, and—"

"Spacecraft have gone to the Belt on ordinary rockets. Why do you need a fusion system?"

"Those were unmanned vehicles. This mission will carry a crew of four, maybe six."

"To the Asteroid Belt? Why?"

"To start prospecting for the metals and minerals that the people of Earth need," Dan said.

Cardenas' face turned stony. Coldly, she asked, "What are you trying to accomplish, Mr. Randolph?"

"I'm trying to save the Earth. I know that sounds pompous, but if we don't—"

"I see no reason to save the Earth," Cardenas said flatly.

Dan gaped at her.

"They got themselves into this greenhouse mess. They were warned, but they paid no attention. The politicians, the business leaders, the news media . . . none of them lifted a finger until it was too late."

"That's not entirely true," Dan said softly, remembering his own struggles to get the world's leaders to recognize the looming greenhouse cliff before it struck.

"True enough," Cardenas replied. "And then there's the New Morality and all those other ultraconservative cults. Why do you want to save them?"

"They're people," Dan blurted. "Human beings."

"Let them sink in their own filth," Cardenas said, her words dripping acid. "They've earned whatever they get."

"But . . ." Dan felt completely at sea. "I don't understand . . ."

"They exiled me." She almost snarled the words. "Because I injected nanomachines into my body, they prevented me from returning to Earth. Their fanatics assassinated anyone who spoke in favor of nanotechnology, did you know that?"

Dan shook his head mutely.

"They attacked Moonbase, back before it became Selene. One of their suicide killers blew up Professor Zimmerman in his own lab. And you want me to help them?"

Shocked by her vehemence, Dan mumbled, "But that was years ago . . ."

"I was there, Mr. Randolph. I saw the mangled bodies. And then, when we won and even the old United Nations had to recognize our independence, those hypocritical ignoramuses passed laws exiling anyone who had accepted nanomachines into their body."

"I understand that, but—"

"I had a husband," she went on, blue eyes snapping. "I had two daughters. I have four grandchildren in college that I've never touched! Never held them as babies. Never sat down at the same table with them."

Another woman might have burst

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into tears, Dan thought. But Cardenas was too furious for that. How the hell can I reach her? he wondered.

She seemed to recover herself. Placing both hands on her desktop, she said more mildly, "I'm sorry for the tirade. But I want you to understand why I'm not particularly interested in helping the people of Earth."

Dan replied, "Then how about helping the people of Selene?"

Her chin went up a notch. "What do you mean?"

"A working fusion drive can make it economical to mine hydrates from the carbonaceous asteroids. Even scoop water vapor from comets."

She thought about that for a moment. Then, "Or even scoop fusion fuels from Jupiter, I imagine."

Dan stared at her. Twelve lords a-leaping, I hadn't even thought of that. Jupiter's atmosphere must be loaded with hydrogen and helium isotopes.

Cardenas smiled slightly. "I presume you could make a considerable fortune from all this."

"I've offered to do it at cost."

He brows rose. "At cost?"

He hesitated, then admitted, "I want to help the people of Earth. There's ten billion of them, less the millions who've already been killed in the floods and epidemics and famines. They're not all bad guys."

Cardenas looked away from him for a moment, then admitted, "No, I suppose they're not."

"Your grandchildren are down there."

"That's a low blow, Mr. Randolph."

"Dan."

"It's still a low blow, and you know it."

He smiled at her. "I'm not above a rabbit punch or two if it'll get the job done."

She did not smile back. But she said, "I'll spin this Mars work off to a couple of my students. It's mostly routine now, anyway. I'll be back in Selene within the week."

"Thanks. You're doing the right thing," Dan said.

"I'm not as sure of that as you are."

He got up from his chair. "I guess we'll just have to see where it all leads."

"Yes, we will," she agreed.

Dan shook hands with her again and then left her office. Don't linger once you get what you want. Never give the other side the chance to reconsider. He had Cardenas' agreement, no matter that it was reluctant.

OK, I've got the team I need. Duncan and his crew can stay Earthside. Cardenas will direct the construction job.

Now to confront Humphries.

SELENE

". . . and he's madder'n hell," Pancho finished.

Dan nodded somberly as they rode an electric cart through the tunnel from the spaceport to Selene proper. Pancho had been at the spaceport to meet him on his return flight from *Nueva Venezuela*, looking worried, almost frightened about Humphries.

"I guess I'd be ticked off, too," he said, "if our positions were reversed."

The two of them were alone in the cart. Dan had deliberately waited until the four other passengers of the transfer ship had gone off toward the city. Then he and Pancho had clambered aboard the next cart. The automated vehicles ran like clockwork along the long, straight tunnel.

"What do you want to do?" Pancho asked.

Dan grinned at her. "I'll call him and arrange a meeting."

"At the O.K. Corral?"

"No," he said, laughing. "Nothing so grim. It's time he and I talked about structuring a deal together."

Frowning, Pancho asked, "Do you really need him now? I mean with the nanotech and all? Can't you run this show yourself and keep him out of it?"

"I don't think that would be the smart thing to do," Dan replied. "After all, he

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did start me off on this fusion business. If I tried to cut him out altogether he'd have a legitimate gripe."

"That's what he expects you to do."

Dan watched the play of shadows over her face as the cart glided silently along the tunnel. Light and shadow, light and shadow, like watching a speeded-up video of the Sun going across the sky.

"I don't play the game the same way he does," he said at last. "And I don't want this project tied up by lawyers for the next ninety-nine years."

Pancho grunted with distaste. "Lawyers."

"Humphries brought the fusion project to me because he wants to get into Astro. I know how he works. He figures that he'll finance the fusion work in exchange for a bloc of Astro's stock. Then he'll finagle some more stock, put a couple of his clones on my board of directors, and sooner or later toss me out of my own company."

"Can he do that?"

"That's the way he operates. He's snatched half a dozen corporations that way. Right now he's on the verge of taking over Masterson Aerospace."

"Masterson?" Pancho looked shocked.

Dan said, "Yep. Half the world drowning and the rest cooking from this double-damned greenhouse and he's using it to snatch and grab. He's a goddamned opportunist. A vampire, sucking the life out of everything he touches."

"So what are you gonna do?"

"Keep his investment in the fusion project to a minimum," Dan said. "And keep the fusion project separate and apart from Astro Corporation."

"Good luck," she said glumly.

Dan grinned at her. "Hey, don't look so worried. I've been through this kind of thing before. This is what the corporate jungle is all about."

"Yeah, maybe, but I think he'll get rough if he doesn't get his way. Real rough."

With a brash shrug, Dan replied, "That's why I keep Big George around."

"Big George? Who's he?"

Dan had made his quick trip to *Nueva Venezuela* without George. He didn't feel the need for a bodyguard once he was off-Earth. In fact, he hadn't seen the Aussie since they'd arrived together in Selene for his meeting with Doug Stavenger.

"I'll have to introduce you to him."

The cart reached the end of the tunnel and stopped automatically. Dan and Pancho got off; he grabbed his travelbag and they walked to the customs inspection station. Dan saw that the two uniformed inspectors were still checking the quartet of people who had arrived on his flight. On the other side of the area, by the entrance gate, an elderly couple was saying goodbye to a young family with two children, one of them a tot squirming in her mother's arms.

"So whattaya want me to tell Humphries?" Pancho asked. "He'll wanna know how you did with Dr. Cardenas."

"Tell him the truth. Cardenas is joining the team. She'll be here in a few days."

"Should I tell him you want to set up a meeting with him?"

Dan thought it over as they stepped up to the customs desk. "No," he said at last. "I'll call him myself as soon as we get down to our quarters."

Humphries seemed surprised when Dan called him, but he quickly agreed to a meeting the very next morning. He insisted on having the meeting in the Humphries Space System's suite of offices, up in the same tower on the Grand Plaza that housed Doug Stavenger's office.

Dan accepted meekly enough, laughing inwardly at Humphries' gamesmanship. He tried to phone Big George, got only his answering machine, and left a message for George to call him first thing in the morning. Then he undressed, showered, and went to bed.

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He dreamed about Jane. They were together on Tetiaroa, completely alone on the tropical atoll beneath a gorgeous star-strewn sky, walking along the lagoon beach while the balmy wind set the palm trees to rustling softly. A slim crescent of a Moon rode past scudding silvery clouds. Jane was wearing a filmy robe, her auburn hair undone and flowing past her shoulders. In the starlight he could see how beautiful she was, how desirable.

But he could not speak a word. Somehow, no matter how hard he tried, no sound would come out of his mouth. This is stupid, Dan raged at himself. How can you tell her you love her if you can't talk?

The clouds thickened, darkened, blotted out the Moon and stars. Beyond Jane's shadowy profile Dan could see the ocean stirring, frothing, an enormous tidal wave rising up higher, higher, a mountain of foaming water rushing down on them. He tried to warn her, tried to shout but the water crashed down on them both with crushing force. He reached for Jane, to hold her, to save her, but she was wrenched out of his arms.

He woke, sitting up and drenched with sweat. His throat felt raw, as if he'd been screaming for hours. He didn't know where he was. In the darkness of the bedroom all he could see was the green glowing numerals on the digital clock on the night table. He rubbed at his eyes, working hard to remember. Selene. I'm in the company suite in Selene. I'm going to see Humphries first thing in the morning.

And Jane's dead.

"You've been quite a busy fellow," Humphries said, with obviously false joviality.

Instead of meeting in his personal office, he had invited Dan to a small windowless conference room. Not even holoviews on the walls, only a few paintings and photographs of Martin Humphries with celebrities of various stripe. Dan recognized the current President of the United States, a dour-faced elderly man in black clerical garb, and Vasily Malik of the GEC.

Leaning back relaxedly in the comfortable padded chair, Dan said, "I guess I have been on the go quite a bit since we last met."

Sitting across the table from Dan, Humphries clasped his hands together atop its gleaming surface. "To tell you the truth, Dan, I get the feeling you're trying to screw me out of this fusion operation."

Laughing, Dan said, "I wouldn't do that, Marty, even if I could."

Humphries laughed back at him. It seemed more than a little forced to Dan.

"Tell me something," Dan said. "You didn't stumble across Duncan by accident, did you?"

Humphries smiled more genuinely. "Not entirely. When I started Humphries Space Systems I went out and backed more than a dozen small, longshot research groups. I figured that one of them was bound to come through with something. You ought to see some of the kooks I had to deal with!"

"I can imagine," Dan said, grinning. He'd had his share of earnest zanies trying to convince him of one wild scheme or another, over the years.

"I got lucky with Duncan and this fusion rocket," Humphries went on, looking pleased with himself.

"It was more than luck," Dan said. "You were damned smart."

"Maybe," Humphries agreed. "It only takes one swing to hit a home run."

"And it doesn't cost much, either, at the laboratory stage."

Nodding, Humphries said, "If more people backed basic research we'd get ahead a lot faster,"

"I should've done it myself," Dan admitted.

"Yes, you should have."

"My mistake."

"OK then, where do we stand?"

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Humphries asked.

"Well . . . you financed Duncan's original work."

"Including the flight tests that you saw," Humphries pointed out.

Dan nodded. "I've been trying to put together the financing for building a full-scale spacecraft and sending a team out to the Belt."

"I can finance that. I told you I'd put up the money."

"Yep. But it'd cost me a good chunk of Astro Corporation, wouldn't it?"

"We can negotiate a reasonable price. It won't cost you a cent out of pocket."

"But you'd wind up owning Astro," Dan said flatly.

Something flashed in Humphries' eyes for a moment. But he quickly put on a synthetic smile. "How could I take over Astro Manufacturing, Dan? I know you wouldn't part with more than fifteen, twenty percent of your company."

"More like five or ten percent," Dan said.

"Even worse, for me. I'd be a minority stockholder. I wouldn't even be able to put anybody on the board—except myself, I imagine."

Dan said, "H'mm."

Hunching closer, Humphries said, "I hear you're going the nanotech route."

"You hear right," Dan replied. "Dr. Cardenas is returning to Selene to head up the job."

"I hadn't thought about using nanomachines. Makes sense."

"Brings the cost down."

"Makes my investment smaller," Humphries said, straight-faced.

Tired of the fencing, Dan said, "Look, here's the way I see this. We bring Selene in as a third partner. They provide the facilities and nanotech personnel."

"I thought you were recruiting retirees," Humphries said.

"Some," Dan admitted, "but we'll still need Selene's active help."

"So we've got a third partner," Humphries said sullenly.

"I want to form a separate corporation, separate and apart from Astro. We'll each be one-third owners: you, me, and Selene."

Humphries sat up straighter. "What's the matter, Dan, don't you trust me?"

"Not as far as I can throw the Rock of Gibraltar."

Another man might have laughed grudgingly. Humphries glared at Dan for a moment, his face reddening. But then he got himself under control and shrugged nonchalantly.

"You don't want to let me have any Astro stock, do you?"

"Not if I can help it," Dan said pleasantly.

"But then what are you bringing into this deal? I've got the money, Selene's got the personnel and facilities. What do you offer?"

Dan smiled his widest. "My management skills. After all, I'm the one who came up with the nanotech idea."

"I thought it was Stavenger's idea."

Dan felt his brows hike up. And his respect for Humphries' sources of information. He didn't get that from Pancho; I didn't tell her. Does he have Stavenger's office bugged? Or infiltrated?

"Tell you what," said Dan. "Just to show you that I'm not such a suspicious sonofabitch, I'll chip in five percent of Astro's stock. Out of my personal holdings."

"Ten," Humphries immediately shot back.

"Five."

"Come on, Dan. You can't get out of this so cheaply."

Dan looked up at the panelled ceiling, took a deep breath, looked back into Humphries' icy gray eyes.

Finally he said, "Seven."

"Eight."

Dan cocked his head slightly, then murmured, "Deal."

Humphries smiled, genuinely this time, and echoed, "Deal."

Each man extended his hand across the table. As they shook hands, Dan said to himself, Count your fingers after he lets go.

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SELENE NANOTECHNOLOGY LABORATORY

Dan was watching intently as Kris Cardenas manipulated the roller dial with one manicured finger, her eyes riveted on the scanning microscope's display screen. The image took shape on the screen, blurred, then came into crisp focus.

The picture was grainy, gray on gray, with a slightly greenish cast. Dan could make out a pair of fuel tanks with piping that led to a spherical chamber. On the other side of the sphere was a narrow straight channel that ended in the flared bell of a rocket nozzle.

"It's the whole assembly!" he blurted.

Cardenas turned toward him with a bright California smile. "Not bad for a month's work, is it?"

Dan grinned back at her. "Kinda small, though, don't you think?"

They were alone in the nanotech lab this late at night. The other workstations were empty, all the cubicles dark, the ceiling lights turned down to their dim nighttime setting. Only in the corner where Dan and Cardenas sat on a pair of swivel stools were the overhead lights at their full brightness. The massive gray tubing of the scanning microscope loomed above them both like a hulking robot. Dan marvelled inwardly that the big, bulky machine was capable of revealing individual atoms.

Cardenas said, "Size isn't important right now. It's the pattern that counts."

"Swell," said Dan. "If I want to send a team of bacteria to the Belt, you've got the fusion drive all set for them."

"Don't be obtuse, Dan."

"I was trying to be funny."

Cardenas did not appreciate his humor. Tapping a bright blue-polished fingernail against the microscope's display screen, she said, "We've programmed this set of nanos to understand the pattern of your fusion system: the tankage, the reactor chamber, the MHD channel and the rocket nozzle."

"Plus all the plumbing."

"And the plumbing, yes. Now that they've learned the pattern, it's just a matter of programming them to build the same thing at full scale."

Dan scratched his chin, then said, "And the full-scale job will be able to handle the necessary pressures and temperatures?"

"Most of it's built of diamond."

That wasn't an answer to his question, Dan realized. OK, so the virus-sized nanomachines could take individual atoms of carbon from a pile of soot and put them together one by one to build structures with the strength and thermal properties of pure diamond.

"But will that do the job?" he asked Cardenas.

Her lips became a tight line. She was obviously unhappy about something.

"Problem?" Dan asked.

"Not really," Cardenas said. "But . . ."

"But what? I've got to know, Kris. I'm hanging my *cojones* out in the breeze on this."

Raising both hands in a don't-blame-me gesture, she said, "It's Duncan. He refuses to come up here. None of his team will leave Earth."

Dan had known that Duncan, Vertientes and the rest of the team had opted to remain Earthside and communicate with Cardenas and her nanotech people electronically.

"You talk to him every day, don't you?"

"Sure we do. We even have interactive VR sessions, if you can call them interactive."

Feeling alarmed, Dan asked, "What's wrong?"

"It's that damned three-second lag," Cardenas said. "You can't really be interactive, you can't even have a normal conversation when there's three seconds between your question and their answer every blasted time."

"Is it actually hindering your work?"

She made a face somewhere between

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a grimace and a pout. "Not hindering, exactly. It's just so damned inconvenient! And time-consuming. Sometimes we have to go over a thing two or three times just to be sure we've heard them right. It soaks up time and makes everybody edgy."

Dan thought it over. "Maybe I can talk them into coming up here."

"I've tried to, God knows. Duncan won't budge. Neither will any of his people. They're terrified of nanomachines."

"No!"

"Yes. Even Professor Vertientes. You'd think he'd know better, at his age."

"They're scared of nanomachines?"

"They won't admit it, of course," said Cardenas. "They say that they might not be allowed to return to Earth if the authorities know that they've been working with nanomachines. I think that's a crock; they're just plain scared."

"Maybe not," Dan said. "Those Earthside bureaucrats get wonky ideas, especially about nanotechnology. I sure haven't told anybody that I'm dealing with nanomachines."

Her brows shot up. "But everybody knows—"

"Everybody knows that *you* and your staff are building a fusion rocket with nanos. As far as the general public is concerned, I don't come near 'em. I'm a bigshot tycoon, I don't get involved in the dirty work. I've never even been in your lab."

Cardenas nodded with newfound understanding. "That's why you sneak in here late at night."

"I don't sneak anywhere," Dan said, with great dignity. "I've never been here. Period."

She laughed. "Of course."

"Kris," he said, more seriously, "I think Duncan and the rest of them have legitimate reasons to be scared of coming up here and working with you. I'm afraid you're going to have to live with that three-second lag. It's their safety net."

Cardenas took a deep breath. "If I have to."

"You've accomplished a helluva lot in just four weeks," Dan pointed out.

"I suppose that's true. It's just . . . it'd be so much easier if we could all work together under the same roof."

Smiling gently, Dan said, "I never promised you a rose garden."

She was about to reply when the door to the corridor banged open, all the way across the mostly-darkened laboratory. Instinctively, Dan started to duck behind the big microscope tube, like a boy hiding from his mother.

Then he recognized the hulking, shaggy, red-bearded figure of Big George Ambrose.

"That you, Dan?" George called as he strode between workstations toward them. "Been lookin' everywhere for you, y'know."

Despite his size, George moved gracefully, light on his feet and perfectly at home in the low lunar gravity.

"I'm not here," Dan growled.

"Right. But if you were, I'd hafta tell you that Pancho Lane's missin'."

"Missing?"

"Not in her quarters," George said as he approached. "Not in any of the Astro offices. Not in the spaceport or the Grand Plaza. Not anyplace I've looked. Blyleven's worried about her."

Frank Blyleven was chief of Astro's security department. Dan glanced at Cardenas, then said to George, "She could be in someone else's quarters, you know."

George looked surprised at the idea. "Pancho? She doesn't have a guy and she doesn't sleep around."

"I wouldn't worry—"

"She didn't show up at the office t'-day. She's never missed an hour of work, let alone a whole day."

That worried Dan. "Didn't show up at all?"

"I asked everybody. No Pancho, all day. I been lookin' for her all night. Nowhere in sight."

"Did you ask her roommate?"

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"Mandy Cunningham? She was out havin' dinner with Humphries."

"She should be back by now."

George made a leering smirk. "Maybe. Maybe not."

Turning to Cardenas, Dan said, "I'd better look into this. George is right, Pancho's had her nose to the grindstone ever since she came up here."

"So maybe she's taking a little R&R," Cardenas said, unruffled.

"Maybe," Dan admitted. But he didn't think so.

PELICAN BAR

Pancho had spent the entire day being invisible.

The night before, she had gone to the Pelican Bar for a little relaxation after another long, grueling day of study and simulation runs in the Astro office complex.

The incongruously-named Pelican Bar had been started by a homesick Floridian who had come to Selene back in the days when the underground community was still known as Moonbase. Hired to be the base's quartermaster, he had developed a case of hypertension that kept him from returning to Earth until a regime of exercise and medication brought his blood pressure under control.

He took the pills, largely ignored the exercise, and started the bar in his own quarters as a clandestine drinking club for his cronies. Over the years he had grown into a paunchy little barrel of a man, his bald head gleaming under the ceiling fluorescents, a perpetual gap-toothed smile on his fleshy, tattooed face. He often told his patrons that he had found his true calling as a bartender: "A dispenser of cheer and honest advice," as he put it.

The bar was several levels down from the Grand Plaza, the size of two ordinary living suites, carved out of the lunar rock. And quiet. No music, unless someone wanted to sit at the synthesizer that lay dusty and rarely touched in the farthest, most shadowy corner of the room. The only background noise in the place was the buzz of many conversations.

Pelicans were everywhere. A holographic video behind the bar showed them skimming bare centimeters above the placid waters of the Gulf of Mexico against a background of condo towers and beachfront hotels that had long since gone underwater. Photos of pelicans adorned every wall. Statues of pelicans stood at each end of the bar and pelican mobiles hung from the smoothed rock ceiling. A meter-tall stuffed toy pelican stood by the bartender's computer, dressed in garish, outlandish Florida tourist's garb and peering at the drinkers through square little granny sunglasses.

Pancho liked the Pelican Bar. She much preferred it to the tidy little bistro up in the Grand Plaza where the tourists and executives did their drinking. The Pelican was a sort of home away from home; she came often enough to be considered one of the steady customers, and she usually bought as many rounds as any of the drinkers clustered around the bar.

She exchanged greetings with the other regulars while the owner, working behind the bar as usual, broke away from an intense conversation with a despondent-looking little redhead to waddle down the bar and pour Pancho her favorite, a margarita with real lime from Selene's hydroponic fruit orchard.

Although a set of booths lined the back wall, there were no stools at the bar itself. You did your drinking standing up and when you could no longer stand, your buddies took you home. House rules.

Pancho had wedged herself into the crowd in-between a total stranger and a retired engineer she knew only as a fellow Pelican patron whose parents had hung the unlikely name of Isaac Walton around his neck. The word was he had originally come to the Moon to get away

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from jokes about fishing.

Walton's face always seemed slightly askew; one side of it did not quite match the other. Even his graying hair seemed thicker on one side than the other. Normally a happy drinker, he looked morose as he leaned both elbows on the bar and stared into his tall, frosted drink.

"Hi, Ike," Pancho said brightly. "Why the long face?"

"Anniversary," Walton mumbled.

"So where's your wife?"

He gave Pancho a bleary look. "Not my wedding anniversary."

"Then what?"

Walton stood up a little straighter. He was about Pancho's height, stringy and loose-jointed. "The eighth anniversary of my being awarded the Selene Achievement Prize."

"Achievement Prize?" she asked. "What's that?"

The bartender broke into their conversation. "Hey, Ike, don't you think you've had enough for one night?"

Walton nodded solemnly. "Yup. You're right."

"So why don't you go home to your wife," the bartender suggested. Pancho heard something more than friendliness in his tone, an undercurrent of—jeeps, she thought, he almost sounds like a cop.

"You're right, pal. Absolutely right. I'm going home. Whatta I owe you?"

The bartender waved a meaty hand in the air. "Forget it. Anniversary present."

"Thank you very much." Turning to Pancho, he said, "You wanna walk me home?"

She glanced at the bartender, who still looked unusually grim, then shrugged and said, "Sure, Ike. I'll walk you home."

He wasn't as unsteady on his feet as Pancho had thought he'd be. Once outside the bar, Walton seemed more depressed than drunk. Yet he nodded or said hello to everyone they passed.

"What's the Achievement Prize?" Pancho asked as they walked down the corridor.

"Kind of a secret."

"Oh."

"I did the impossible for them, y'see, but I did it too late to be of any use and they don't want anybody to know about it so they gave me the prize as hush money and told me to keep my trap shut."

Confused, Pancho asked, "About what?"

For the first time that evening, Walton broke into a smile. "My cloak of invisibility," he answered.

Little by little Pancho wormed the story out of him. Walton had been working with Professor Zimmerman, the nanotech genius, when the old U.N. had sent Peacekeeper troops to seize Moonbase.

"Stavenger was in a sweat to develop nonlethal weapons so we could defend ourselves against the Peacekeepers when they got here without killing any of them," Walton said, growing steadier and gloomier with each step along the corridor. "Zimmerman promised Stavenger he'd come up with a way to make our guys invisible, but the bastards killed him when they attacked. Suicide bomber got down to his lab and blew the old man to smithereens."

"Himself, too?" Pancho asked.

"I did say 'suicide,' didn't I? Anyway, the so-called war ended pretty quick and we got our independence. That's when we changed the name from Moonbase to Selene."

"I know."

"For a while there I didn't have anything to do. I'd been Zimmerman's assistant and now the old man was gone."

Walton had doggedly kept working on Zimmerman's idea of finding a method for making a person invisible. And eventually he succeeded.

"But who needs to be invisible?" Walton asked. Before Pancho could answer he went on, "Only somebody who's up to no damn' good, that's who. Spies. Assassins. Crooks. Thieves."

Selene's governing council decided to

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mothball Walton's invention. Bury it so that no one would even know it existed.

"So they gave me the big fat prize to keep me quiet. It's a pension, really. I can live in comfort—as long as I stay in Selene and keep my mouth shut."

"Sounds cool to me," Pancho said, trying to cheer him up.

But Walton shook his head. "You don't understand, Pancho. I'm a freaking genius and nobody knows it. I've made a terrific invention and it's useless. I'm not even supposed to mention it to anybody."

Pancho said, "Aren't you taking a chance, talking to me about it?"

He gave her a sidelong glance. "Aw, hell, Pancho, I hadda tell somebody tonight or bust. And I can trust you, can't I? You're not gonna steal it and go out and assassinate anybody, are you?"

"'Course not," Pancho answered immediately. But she was thinking that it might be a hoot to be invisible now and then.

"Wanna see it?" Walton asked.

"The invisibility dingus?"

"Yeah."

"If it's invisible, how can I see it?"

Walton broke into a cackle of laughter. Clapping Pancho on the back, he said, "That's what I like about you, Pancho ol' pal. You're OK, with a capital Oke."

Walton turned down the next cross-corridor and led Pancho up to the level just below the Grand Plaza, where most of Selene's life-support machinery chugged away, purifying the air, recycling the water, rectifying the electrical current coming in from the solar farms. Pumps clattered. The air hummed and crackled. The ceilings of these chambers were rough, unfinished rock. Pancho knew that on their other side was either the manicured lawn of the Grand Plaza or the raw regolith of the Moon's surface itself. And along a corridor not far from where they walked lay the catacombs.

"Isn't the dingus under lock and key?" Pancho asked as Walton led her past a long row of metal lockers.

"They don't even know it exists. They think I destroyed it when they gave me their lousy prize. Destroy it, hell! I'll never destroy it. It's the only one in the whole wide solar system."

"Wow."

He nodded absently. "And it's not a 'dingus,' it's a stealth suit."

"Stealth suit," Pancho echoed.

"Like a wetsuit, it covers you from head to toe," he explained in a hushed voice, as if afraid someone would hear him. Pancho strained to listen to him over the background hum and chatter of the machinery.

Pancho followed Walton down the long row of metal lockers. The corridor smelled dusty, unused. The overhead lights were spaced so far apart that there were shadowy pools of darkness every few meters. Walton stopped in front of a locker identified by a serial number. Pancho saw that it had an electronic security lock.

Feeling uneasy, Pancho asked, "Don't they have any guards patrolling up here?"

"Nah. What for? There's cameras at the other end of the corridor, but this old tunnel's like an attic. People store junk up here, personal stuff they don't have room for down in their quarters."

Walton tapped out the security code on the electronic lock and pulled the metal door open. It squealed slightly, as if complaining.

"There it is," he said in a hushed voice.

Hanging inside the locker was a limp bodysuit, deep black.

"Ain't she a beauty?" Walton said as he carefully, lovingly, took the suit from the locker and held it up by its hanger for Pancho to admire.

"It does look almost like a wetsuit," Pancho said, wondering how it could make someone invisible. It glittered darkly in the feeble light from the overhead fluorescents, as if spangled with

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sequins made of onyx.

"The suit's covered with nanocameras and projectors, only a couple of molecules thick. Drove me nuts getting 'em to work right, lemme tell you. I *earned* that prize money."

"Uh-huh," Pancho said, fingering one of the gloved sleeves. The fabric felt soft, pliable, yet somehow—almost gritty, like grains of sand.

"The cameras pick up the scenery around you," Walton was explaining. "The projectors display it. Somebody standing in front of you sees what's behind you. Somebody on your left sees what's on your right. Just like they're looking through you. To all intents and purposes you're invisible."

"It really works?" she asked.

"Computer built into the belt controls it," Walton said. "Batteries are probably flat, but I can charge 'em up easy enough." He pointed to a set of electrical outlets on the smoothed rock wall of the corridor, opposite the lockers.

"But it really works?" she repeated.

He smiled like a proud father. "Want to try it on?"

Grinning back at him, Pancho said, "Sure!"

While Pancho wriggled into the snug-fitting suit Walton plugged the two palm-sized batteries into the nearby electrical outlet. By the time she had pulled on the gloves and fitted the hood over her head, he was snapping the fully-charged batteries into their slots on the suit's waist.

"OK," Walton said, looking her over carefully. "Now pull the face mask down and seal it to the hood."

Narrow goggles covered Pancho's eyes. "I must look like a terrorist, Ike," she muttered, the fabric of the mask's lining tickling her lips.

"In a minute you won't look like anything at all," he said. "Unlatch the safety cover on your belt and press the pressure switch."

Pancho popped the tiny plastic cover and touched the switch beneath it. "OK, now what?" she asked.

"Give it fifteen seconds."

Pancho waited. "So?"

With a lopsided grin, Walton said, "Hold your hand up in front of your face."

Pancho lifted her arm. A pang of shock bolted through her. "I can't see it!"

"Damn' right you can't. You're invisible."

"I am?"

"Can you see yourself?"

Pancho couldn't. Arms, legs, booted feet: she could feel them as normally as always but could not see them.

"You got a full-length mirror in your locker?" she asked excitedly.

"Why the hell would I have a full-length mirror in there?"

"I want to see what I look like!"

"Cripes, Pancho, you don't look like anything. You're completely invisible."

Pancho laughed excitedly. She made up her mind at that moment to borrow Ike's stealth suit. Without telling him about it, of course.

HUMPHRIES TRUST RESEARCH CENTER

Covered from head to toes in the stealth suit, Pancho crept slowly, silently along the corridor of Martin Humphries' palatial underground house. She had come down to the mansion with Amanda, although Mandy didn't know it.

For weeks, Pancho had been dying to root around in Humphries' mansion. The man was so stinky rich, so ruthlessly powerful and sure of himself, Pancho figured that there must be plenty of dirt under his fingernails. Maybe she could find something that would help Dan. Maybe she could find something that would profit her. Or maybe, she thought, burglarizing Humphries' house would just be a hoot, a refreshing break from the endless hours of study that she and Mandy were grinding through. Besides, it'd be fun to wipe that smug smile off the Humper's face.

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So she had borrowed the stealth suit from Walton's locker the very next morning after he'd shown it to her. Pancho had gone to bed that night arguing with herself over whether or not she should ask Ike's permission to use the suit. She had awakened firmly convinced that the less Ike knew, the better off each of them would be. So, with a tote bag swinging from her shoulder, she'd gone to the catacombs instead of to work with Mandy, then detoured to the dusty, seldom-used corridor where Walton had stashed the suit. She remembered the sing-song of the locker's electronic security code and tapped it out without a flaw. With a glance at the tiny red eye of the security camera on the ceiling at the far end of the corridor, Pancho quickly bundled the suit into her tote bag. Security people can't watch every screen every minute, she told herself. Besides, even if one of 'em's watchin', I ain't doin' anything to rouse an alarm.

Pancho then went back to her quarters. Amanda was busily at work in the simulations lab; Pancho had the apartment to herself. Immediately she started putting on the stealth suit.

Once she got it on—and saw in the bedroom's full-length mirror that she was truly invisible—she went out to test the suit. It worked wonderfully well. Pancho walked slowly, carefully, through Selene's corridors, threading her way through the pedestrian traffic. Now and then someone would glance her way, as if they'd seen something out of the corner of their eyes. A stray reflection from the overhead lights, Pancho thought, an unavoidable momentary glitter off the array of nanocameras and projectors. But no one really saw her; she drifted through the crowds like an unseen phantom.

She spent the day wandering ghostlike through Selene, gaining confidence in the suit and her ability to use it. The suit fit her snugly, but the boots attached to its leggings were Ike's size, not her own. Pancho had solved that problem by wadding stockings into the boots. They weren't exactly comfortable, but she could walk in them well enough.

For kicks, she lifted a soyburger from the counter of the fast-food cafeteria up in the Grand Plaza when no one was working the place except a dumb-ass robot. She immediately realized, though, that if anyone saw a soyburger floating in midair it would cause a fuss, so she dropped it into the recycler at the end of the counter before anyone noticed her.

By midafternoon, Pancho returned briefly to her quarters, took off the suit and dashed out for a quick meal. She was famished. Being invisible makes you hungry, she joked to herself. By the time Amanda returned from her day's work and began dressing for her dinner with Martin Humphries, Pancho was back in the stealth suit, standing quietly in a corner of the bedroom, waiting for Amanda to finish her damned primping and go out.

A cloak of invisibility, Pancho thought as she rode the escalators a few steps ahead of Amanda, down to Selene's bottom layer. What did they call those fancy suits the toreadors wear? A suit of lights, she remembered. Well, I'm wearing a suit of darkness. A cloak of invisibility.

She had to keep her distance from everyone. If somebody jostled her, they'd know she was there, invisible or not. Pancho felt glad that Selene did not allow pets. A dog would probably have sniffed her out easily.

The escalators got less and less crowded as she went down level after level. By the time she was riding down to the last level, she and Amanda were alone on the moving stairs. Once at the bottom, she waited for Amanda, then fell into step behind her. Mandy was heading for a private little dinner with Humphries. Just the two of them, they thought. Pancho smiled to herself. If the Humper tries anything Mandy doesn't

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like, I'll cold-cock him. I'll be her guardian angel. Then she wondered just how far Mandy was willing to go with Humphries—and how far she could tease him without getting herself into real trouble. Well, she shrugged to herself, Mandy's a grownup, she knows what she's doing. Or she ought to.

Mandy looked like a princess in a fairy tale, wearing a short-sleeved frock of baby blue with a knee-length fringed skirt. Modest enough, Pancho thought, although on Mandy nothing could look really modest. Not in the eyes of a man like Humphries, anyway. Pancho didn't recall seeing the dress before; Mandy must have bought it in one of Selene's shops. Everything cost a fortune there, except for stuff actually made on the Moon. Is Humphries buying her clothes? Pancho wondered. He hadn't given Mandy any jewelry, she was sure of that. Mandy would have showed it off if he had.

Amanda walked purposefully down the length of the corridor and into the grotto that housed the Humphries Trust research garden and house. Humphries was at the front door to greet her, all smiles. Pancho slipped in behind her, nearly brushing Humphries' hand as he pulled the door shut. If the Humper felt anything, he didn't show it. Pancho was in the house and he didn't know it.

As Humphries guided Amanda off to the bar, Pancho stood stock-still in the foyer. A man like Humphries would have a state-of-the-art security system in his home, she reasoned. No matter that the house was in Selene; Humphries would insist on topflight security. He might give the human staff the night off for his dates, but he wouldn't turn off his alarm systems. Motion sensors were her big worry. Humphries obviously wouldn't have any working in the residential wing of the house. But the offices would be another thing altogether. She could see the long, spacious living room and the corridor that led to the formal dining room and, beyond it, the library/bar. That was the direction Humphries and Amanda had gone.

On the other side of the foyer was a single closed door. Pancho guessed that it opened onto the suite of offices and laboratories that the ecologists used. Would he have motion sensors set up in there? Probably not, she thought, but if he did . . .

There must be a central control for the security system. Most likely in Humphries' own bedroom or his office. His bedroom? Pancho grinned at the thought. That's one room in the house where he'd have any motion sensors definitely turned off!

Slowly, on tiptoes despite the thick carpeting, Pancho made her way up to the second floor. The master bedroom was easy to find: beautifully-carved double doors at the end of the hallway. She eased the door open. No sirens, no hooting klaxons. Could be silent alarms, she told herself, but if he's dismissed the servants for the night he'll have to come up here his own self, and I can handle that, easy.

The room was sumptuous, and Humphries' bed was enormous, like a tennis court. That bed could handle a whole squad of cheerleaders, she thought. Prob'ly has, Pancho told herself.

Through a half-open door she saw a desktop computer, its screen saver showing some old master's painting of a nude woman. As Pancho cautiously approached the door and eased it all the way open, the screen's image dissolved into another painting of another nude. Huh! she grunted. Some art lover.

Pancho sat at the desk and saw that the computer had a keyboard attached to it. Tentatively, she pecked at the ENTER key. The artwork vanished and a honey-warm woman's voice said, "Good evening, Mr. Humphries. The time is eight-twelve and I'm ready to go to work anytime you are."

Frowning, Pancho turned the audio down to zero. The screen displayed a

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menu of options. Hell, he doesn't have any protection on his programs at all. She pictured Humphries at his computer, too impatient to deal with code words and security safeguards. After all, who'd have the balls to break into his home, his own bedroom?

Grinning from ear to ear, Pancho delved into Martin Humphries' computer files.

It turned out that most of the individual file names were indeed coded and incomprehensible to her. So he does have some security built into his programs, she realized. Many of the files required special keywords. One, though, was labelled BED. Curious, Pancho called it up. The screen went blank, except for the words INITIATING HOLOTANK. An eyeblink later the screen announced STARTING HOLOTANK. Then the screen went to a blank gray, except for a bar across its bottom that bore video commands.

Puzzled, Pancho saw a blur of color reflected off the blanked screen. Turning slightly in the desk chair, she saw that what had appeared to be a cylindrical glass *objet d'art* had metamorphosed into a hologram, a full-color three-dimensional moving picture of Humphries naked in bed with some woman.

Son of a bitch, Pancho said to herself. He vids his own sex life. She watched for a few moments. They weren't doing anything that unusual, or thrilling, for that matter, so Pancho touched the fast-forward button on the screen.

It was downright funny watching Humphries and his women in fast-forward. He's a Humper, all right, Pancho thought as she watched a succession of beautiful naked women performing arduously with him. She recognized the redhead from her first visit to the house. I wonder if they know they're being videoed, she asked herself.

After a half-dozen of Humphries' home videos, Pancho got a little bored. She cut the program and returned to the screen's menu of options, but she had new respect for the program labelled VR - PERSONAL. She looked into just one of its files for a few minutes, then angrily clicked it off, revolted.

The nasty S.O.B. uses his bedmates as models for his virtual reality fantasies, she realized. What he can't get them to do in real life he has them doing in his VR wet dreams. Creep!

With a disgusted shake of her head she decided to leave Humphries' sex life alone and started hacking into the other files.

When she glanced at the digital clock in the corner of the screen, Pancho was shocked to realize that nearly two hours had elapsed. It had been a fruitful time, though. The Humphries Trust was now paying the rent on Susan Lane's cryonic storage unit, a big burden off Pancho's shoulders and a picayune pinprick in the Trust's multibillion funds.

Most of the files were incomprehensible to Pancho, some were technobabble and equations, lots of them were stock manipulations and business deals encoded in so much jargon and legalese that it would take a team of lawyers to decipher them. But now they all contained a new subroutine that allowed Pancho to tap into the files from a remote site. Codeword: Hackensack. Which was just what Pancho was preparing to do.

Got to be careful, though, she warned herself. Don't get greedy enough for him to recognize he's being hacked. A man like Humphries'll have you slapped into the slammer so fast it'll break the sound barrier. Or he'll just have somebody pay you a visit and rip out your arms.

Satisfied with her work, Pancho closed down the computer and left Humphries' office, careful to leave the door ajar just the way she'd found it. As she made her way downstairs, she wondered if Mandy and Humphries were still at dinner, after all this time.

They were. Peeking in on the dining room, Pancho saw the remains of some fancy dessert melting in their dishes,

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and half-empty flutes of champagne sparkling in the subdued light from the crystal chandelier above the table.

Mandy was saying, ". . . it's certainly beautiful, Martin, and I appreciate your thoughtfulness, but I can't accept it. Really, I can't."

Pancho crept closer, staring. Humphries held an open jewelry case in one hand. It contained a stunning sapphire necklace.

"I got it specially for you," he was saying, his voice almost pleading.

"Martin, you're a dear man, but I can't get myself involved in a relationship now. You of all people should understand that."

"But I don't understand," he said. "Why not?"

"I'll be heading off on the mission in a few months. I might never come back."

"All the more reason to grab whatever happiness we can now, while we can."

Amanda looked genuinely distressed. Shaking her head, she said, "I simply can't, Martin. I can't."

In a gentle whisper he said, "I could have you removed from the mission. I could see to it that you stay here, with me."

"No. Please . . ."

"I could," he repeated, stronger. "By God, that's what I'll do."

"But I don't want you to," Amanda said, alarmed.

"You don't have to go through with it," Humphries insisted. "I know it's dangerous. I had no idea that you're afraid of—"

"Afraid!" Mandy snapped. "I'm not afraid! Simply because I understand the risks involved does *not* mean that I'm afraid."

Humphries puffed out an exasperated breath. "Then you're using the mission as an excuse to keep your distance from me, is that it?"

"No!" Amanda said. "That's not it at all. I simply . . ." Her voice trailed off into silence.

"Then what's wrong?" Humphries asked. "What's the problem? Is it me?"

She stared down at the table for a long, miserable, silent moment. Pancho thought she saw tears glistening in Mandy's eyes. The expression on Humphries' face was somewhere between bafflement and anger.

"Martin, please," Amanda said at last. "We've only known each other for a few weeks. You're a very wonderful man in many ways, but I'm not ready for a meaningful relationship. Not now. Not with this mission coming up. Perhaps afterward, when I return, perhaps then."

Humphries pulled in a deep breath. It seemed obvious to Pancho that he was trying to control his temper.

"I'm not a patient man," he said, his voice low. "I'm not accustomed to waiting."

No, Pancho thought. What you're accustomed to is taking your women up to your bedroom and videoing the whole thing for playback. And then VR games.

"Please bear with me, Martin," Amanda whispered, her voice husky with tears. "Please."

If he tries to get rough with Mandy, Pancho told herself, I'll kick his balls into next week. She wished she'd brought Elly, but the stealth suit was too confining for the snake; she'd left Elly back at her quarters.

Humphries snapped the jewelry case shut with a click that sounded like a gunshot.

"All right," he said tightly. "I'll wait. I wish I'd never started this fusion business."

Amanda made a sad smile. "But then we'd never have met, would we?"

He conceded the point with a hopeless shrug, then got up and led Amanda to the front door of the house.

"Will I see you again?" he asked as he opened the door for her.

"It might be best if we don't, Martin. Not until after I return."

He nodded, grim faced. Then he grasped both her wrists and said, "I love you, Amanda. I really do."

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"I know," she said, and kissed him swiftly, lightly, on the cheek.

She hurried down the walk away from him so quickly that Pancho almost didn't make it through the door before Humphries slammed it shut.

LIVING QUARTERS

Pancho had to sprint up the escalators to get back to the quarters she shared with Amanda before Mandy did. Twice she nearly stumbled and fell; it wasn't easy to run up moving stairs when you can't see your own feet.

It was late enough so that the corridors were not crowded. Pancho easily dodged around the few people still up and about, leaving a couple of them bewildered as she brushed past them; they felt certain that someone had just rushed by, yet there was no one in sight. She got to their quarters well ahead of Amanda, powered down the stealth suit as soon as she slid the door shut behind her, stripped to her skivvies and stuffed the suit under her bed. Elly was snoozing comfortably in her plastic cage, actually a box that still smelled faintly of the strawberries it had carried from China to Selene. Pancho had packed it with several centimeters of gritty regolith dirt, stuck in an artificial cactus and kept a saucer of water in it for Elly's comfort.

She was kneeling beside the plastic box, pouring fresh water into the saucer when Amanda came in.

Pancho looked up at her roommate. Mandy's eyes were red, as if she'd been crying.

"How'd your date go?" she asked, innocently.

Looking troubled, Amanda said, "Oh, Pancho, I think he wants to marry me."

Pancho got to her feet. "He's not the marrying kind."

"He's been married. Twice."

"That's what I mean."

Amanda sat on her bed. "He . . . he's different from any other man I've ever met."

"Yeah. He's got more money."

"No, it isn't that," Amanda replied. "He's . . ." She searched for a word.

"Horny?" Pancho suggested.

Amanda frowned at her. "He's *powerful*. There's something in his eyes . . . he almost frightens me."

Thinking about Humphries' home videos, Pancho nodded.

"I can't see him again. I simply can't."

She sounded to Pancho as if she were trying to convince herself.

"He's so accustomed to getting whatever he wants," Amanda said, more to herself than Pancho. "He doesn't like being turned away, rejected."

"Nobody does, Mandy."

"But he . . ." Again her words faltered. "Pancho, with other men I could smile and flirt and let it go at that. But Martin won't be satisfied with that. He wants what he wants, and if he doesn't get it, he can be . . . I just don't know what he'd do, but he frightens me."

"You think he wants to marry you?"

"He said he loves me."

"Aw hell, Mandy, guys have said that to me, too. All they want is to get into your pants."

"I think he really believes that he loves me."

"That's a strange way to put it."

"Pancho, I can't see him again. There's no telling what he might do. I've got to stay away from him."

Pancho thought that Amanda looked scared. And she's got plenty to be scared of, she told herself.

First thing the following morning, Pancho phoned Dan Randolph and asked to meet with him. One of Randolph's assistants, the big beefy-faced guy with the sweet tenor voice, said he'd call her back. In five minutes, he did. Randolph would see her in his office at ten-fifteen.

Astro Corporation's offices were just down the corridor from the living quarters that the company rented. In most corporations, executive country was conspicuously more luxurious than the

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regular troops' territory. Not so at Astro. There was no discernable difference along the length of the corridor. As she walked along the row of doors, looking for Randolph's name, Pancho decided that she wouldn't tell him about the stealth suit. She'd returned it first thing that morning to Walton's locker. Ike knew nothing of her borrowing the suit; if there was any bad fallout, he couldn't be blamed for anything.

Randolph looked tense when Pancho was ushered into his office by the big Aussie she'd talked to on the phone.

"Hi, boss," she said brightly.

It was a small office, considering it belonged to the head of a major corporation. There was a desk in one corner, but Randolph was standing by the sofa and cushioned chairs arranged around a coffee table on the opposite side of the room. Pancho saw that the walls were decorated with photos of Astro rockets launching from Earth on tongues of fire and billowing smoke. Nothing personal. No pictures of Randolph himself or anyone else. Pancho grinned inwardly when she saw that Randolph's desk was cluttered with papers, despite the computer built into it. The paperless office was still a myth, she realized.

Gesturing to the sofa, he said, "Have a seat. Have you had breakfast?"

Instead of sitting down, Pancho asked, "Is that a trick question? Astro employees are up at the crack of dawn every day, boss, and twice on Sundays."

Randolph laughed. "Coffee? Tea? Anything?"

"Can I use your computer for a minute?" she asked.

He looked puzzled, but said, "Sure, go ahead." Louder, he called, "Computer, guest voice."

Pancho went to the desk and leaned over the upright display screen. She gave her name and the computer came to life. Within a few seconds, she waved Randolph over to look at the screen.

He peered at the display. "What the hell's that?"

"Martin Humphries' personal menu of programs."

"Humphries?" Randolph sank into his desk chair.

"Yep. I hacked into his machine last night. You can tap in anytime you want."

Randolph looked up at Pancho, then back at his screen. "Without his knowing it?"

"Oh, he'll figger it out sooner or later, I guess. But right now he doesn't know it."

"How the hell did you do this?"

Pancho smiled at him. "Magic."

"H'mp," Randolph grunted. "It's a shame you couldn't do this a few days earlier."

"How come?"

"We're partners now."

"You and Humphries? Partners?"

"Humphries, Selene and Astro. We've formed a limited partnership: Starpower, Ltd."

"Hot spit! Where can I buy stock?"

"It's not public. Duncan and his people will get a block of shares, but otherwise, it's Humphries, me, and the good citizens of Selene. It should help keep Selene's taxes down, if it works."

Feeling a bit disappointed, Pancho grumbled, "Oh, just the big boys, huh?"

Randolph gave her a sly grin. "I suppose," he said, running a finger across his chin, "that we'll award a few shares here and there, for exceptional performances."

"Like piloting a bird to the Belt and back."

Randolph nodded.

"OK," Pancho said, with enthusiasm. "Meanwhile, you can poke into Humphries' files anytime you want to."

Randolph cleared the screen with a single, sharp, "Exit." To Pancho, he said, "You're wasting your time jockeying spacecraft. You make a mighty fine spy, kid."

"I'd rather fly than spy," she said.

Randolph looked at her. He's got really neat eyes, she thought. Gray, but not

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cold. Deep. Flecked with gold. Nice eyes.

"I'm not sure that I want to poke into Humphries' files," he said.

"No?"

"A man named Stimson was the U.S. Secretary of State back a century or more ago," Randolph said. "When he found out that the State Department was routinely intercepting the mail from the foreign embassies in Washington he stopped the practice. He said, 'Gentlemen do not read each other's mail.' Or something like that."

Pancho snorted. "Maybe you're a gentleman, but Humphries sure ain't."

"I think you're half right."

"Which half?"

Instead of answering, Randolph tapped a button on the phone console. The big Australian came through the door from the outer office almost instantly.

"You two know each other?" Randolph asked. Without waiting for a reply from either of them, he said, "George Ambrose, Pancho Lane."

"Pleased," said Big George. Pancho made a quick smile.

"George, who do we have who can download a complete hard drive without letting the hard drive's owner know it?"

Big George glanced at Pancho, then asked, "You want this done as quiet as possible, right?"

"Absolutely right."

"Then I'll do it meself."

"You?"

"Don't look so surprised," George said. "I used to be an engineer, before I hooked up with you."

"You were a fugitive from justice before you hooked up with me," Randolph countered.

"Yeah, yeah, but before that. I came to the Moon to teleoperate tractors up on the surface. My bloody degree's in software architecture, for chrissakes."

"I didn't know that," Randolph said.

"Well, now you do. So what needs doing here?"

"I'd like you to work with Pancho here. She'll explain the problem."

George looked at her. "OK. When do we start?"

"Now," said Randolph. Then, to Pancho, he added, "You can tell George anything you'd tell me."

"Sure," Pancho agreed. But in her mind she added, Maybe. ■

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THE REFERENCE LIBRARY Tom Easton

Ventus, Karl Schroeder, TOR, $27.95, 477 pp. (ISBN: 0-312-87197-X).

Abandon in Place, Jerry Oltion, TOR, $24.95, 365 pp. (ISBN: 0-312-87264-X).

The Phoenix Code, Catherine Asaro, Bantam, $5.99, 333 pp. (ISBN: 0-553-58154-6).

Jupiter, Ben Bova, TOR, $24.95, 368 pp. (ISBN: 0-312-87217-8).

Colony Fleet, Susan R. Matthews, Avon, $6.50, 295 pp. (ISBN: 0-380-80316-X).

Menace: Battle Mountain, Alan Rodgers, Wildside Press, $13.95, 106 pp. (ISBN: 1-587-15197-9).

The Truth, Terry Pratchett, Harper Collins, $24, 324 pp. (ISBN: 0-380-97895-4).

Island of the Sequined Love Nun, Christopher Moore, Avon, $13, 325 pp. (ISBN: 0-380-81654-7).

The Lust Lizard of Melancholy Cove, Christopher Moore, Avon, $13, 304 pp. (ISBN: 0-380-79274-5).

Worlds Vast and Various, Gregory Benford, Avon, $13.50, 312 pp. (ISBN: 0-380-79054-8).

Magic Feathers: The Mike & Nick Show, Obscura press (P.O. Box 1992, Ames, Iowa 50010-1992), $12.95, 223 pp. (ISBN: 0-9659569-2-X).

One of the basic causes of environmental (and other) problems is that people tend to define things in relation to themselves. Thus, nature has had value largely only insofar as it could be turned into products (oil, gold, lumber, farm crops, etc.) and money; "wilderness" and "wasteland" have been synonyms; the Homestead Act required that land be "improved" with buildings; and so on. We're getting away from that a bit, as some environmental philosophers have tried to explicate nature's value in its own terms, irrespective of our presence. But it is difficult to come up with a convincing rationale for protecting nature that does not boil down to "Because it is valuable to us, because it does us good," in terms of unexplored genetic resources, flood control, erosion control, our dependence upon the natural systems that sustain us. It is also difficult to come up with a rationale that includes humans; there is a tendency among both environmentalists and anti-environmentalists to put "humans" and "nature" in opposing camps.

Is there any way to resolve the oppositions here? Karl Schroeder suggests that artificial intelligence and nanotechnology may offer a way. In **Ventus**, he gives us a world to which humans sent a cloud of nanotech terraformers a thousand years ago. The machines gave rise to entities known to later settlers as "Winds"; they constructed soil, fresh water, and landscapes; they seeded the planet with familiar life forms; they built homes for future settlers; and they became part of every bug, bird, stone, plant, and drop of water. And when those settlers eventually appeared, they turned on them, reducing them to a medievaloid level of technology. The key is apparently that their programming had been infected with "thalience"—a tendency to define themselves in their own terms, not humanity's, and for all their creations—bugs, birds, trees, soil, water—to do likewise.

The settlers came to terms with this. The Winds are gods, as arbitrary and

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capricious as any, and that's the way things are. But now we have offworlders on the scene. Calandria May and Axel Chan are hunting Armiger, a man who had been the puppet of an AI deathlord they had helped destroy. He may or may not carry a resurrection seed for the deathlord; either way he must be found. Fortunately, Calandria has stumbled on Jordan Mason, a boy who—because Armiger planted in his head a nanotech tap—can see through Armiger's eyes even as he lies in a tomb, scrabbling at the stone around him.

Jordan grows up. Armiger discovers his humanity. A utopian queen faces rebellion and massacre. The greater human civilization considers sterilizing Ventus to make sure the deathlord cannot rise again. The Winds hover over all, hunting out anomalies such as Jordan and Armiger and arguing with each other over the ultimate place of thalience.

Ventus is a grand adventure with satisfyingly meaty content. It's Schroeder's second novel (after the fantasy *The Claus Effect*), and it promises him a successful career in the game.

I must admit that when I read the jacket copy for Jerry Oltion's **Abandon in Place**, I was skeptical. Neil Armstrong—the man whose name stands more than any other for the Apollo Program, for he was the first to carry the banner of humanity to the surface of the Moon—dies, and a ghost Saturn-V launches from an abandoned pad at Cape Canaveral. It goes all the way to the Moon, where the Lunar Excursion Module properly separates and descends to the point where a human hand would have to take the helm. And then it vanishes.

At the next launch window, it happens again. And then astronaut Rick Spencer climbs aboard to ride that thundering tower of sheer, magnificent spirit into orbit.

Yeah, right, I thought. Suurre. But it felt so damned *true*. The old space program is indeed dead, nothing left but the spirit that clings to a few old farts. Once that spirit was a grand and glorious thing, and it would be entirely appropriate for it to take ghostly form to taunt us into pursuing it once more.

Yet that's not quite the story. Spencer rides his Saturn, true enough. He's supposed to park it in orbit, where it can be used to build nice, safe, mundane space stations and such. But he was a space geek as a kid. He's tempted, and he succumbs: "Hey, guys," he hollers to the Shuttle that's supposed to take him home. "Anybody want a ride?"

His girlfriend Tessa joins him. So does a Japanese mission specialist. And as Capcom raves, and a laughing Russian offers to take over the ground control job, they're off, all the way to the Moon. In the process, they discover that the thing they're riding depends on their belief in it—if they falter, it starts to fade out. And when they return—with Rick and Tessa engaged—it turns out that public belief is also crucial.

There are a good many implications there, and Oltion explores a few of them to good effect. But no effect is grander than the core conceit, the metaphor that plays on the concept of "public support" and insists that if only that support can be revived and sustained and even turned into public involvement, we can go to the Moon, and Mars, and beyond!

Oltion's imagery is so engaging from beginning to end that it seems inevitable that there will be a movie.

Catherine Asaro began combining SF and romance with an artificial intelligence angle in *The Veiled Web*, where dancer Lucia del Mar fell in with Rashid al-Jazari, gorgeous businessman and AI researcher, and discovered in herself a gift for one aspect of hubby's work.

In **The Phoenix Code**, Asaro returns to flipping romantic traditions on their heads while remaining truer than ever to the SF form. *Code* is set in the same world as *Web* and even refers to its

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events, but here the ace researcher is Megan O'Flannery, recruited to rescue an effort to develop a robot that will look and act like a human being successfully enough to pass—both in interactions with real humans and through airport metal detectors. Her predecessors in MindSim's high-security underground lab have failed, their robots gone mad or catatonic. She, however, has a gift for loosening up the robot's internal controls just enough to make it work.

Perhaps she loosens those controls up too much. When Ray Sundaram, ace researcher in his own right, shows up to help, the robot—Ander—is clearly jealous.

Can a robot love? This is one of the questions that bedevils the field and makes many people say, "Of course not! It's just a machine!" But if AI ever succeeds—if a robot ever "passes" successfully—it will have to be able to feel love, hate, fear, and all the other soft, gushy, "meat" emotions on which people think they have a monopoly.

Ander's internal turmoil leads it—or him—to kidnap Megan and Raj and hare off on a search for others of his kind, the survivors of a competing company's failed Phoenix Project. After suitable adventures and debates, there is even an answer to the question of just how well a robot can pass. But all I'll say here is that that answer is bound to surprise most readers. It may even offend some.

Intrigued? Buy the book. Catherine Asaro has the gift.

The future of Ben Bova's **Jupiter** is something of a hell for rationalists and secular humanists. The fundamentalists have taken over the world and established a "New Morality" of blind adherence to dogma. Evolution is, of course, a dirty word.

Pity poor Grant Archer. He just wants to get his doctorate in astrophysics. He's counting on the system to honor its promises and send him to the far side of the Moon to do the necessary research. But the local Cotton Mather instead says, "Nope, boy. You're going to the research station orbiting Jupiter. The godless scientists there are trying to find"—gasp!—"intelligent aliens in old Jove's sea, and you'll be our spy. Never mind that the year's travel time doesn't count toward your public service commitment. Never mind that your bride awaits on Earth. You *are* loyal. Aren't you?"

What can he say? Life is tough. And the folks at Jupiter are indeed up to something. That's obvious as soon as he spots the saucerlike attachment to the station, the surgical modifications to certain researchers, and the talking gorilla. Pretty soon he's no longer pining for his lost astrophysics; he's working on Jovian fluid dynamics, thinking about the difficulties of surviving in the high pressures of its liquid sea, and wondering about aliens himself.

He's a lousy spy, but he's an excellent choice for a protagonist—he's caught between a rock and a hard place at least twice, he's a classic innocent, he has a lot to learn, and in the end he has an important part to play. Bova has once more crafted a very readable tale in the classic vein beloved of *Analog* readers.

Enjoy.

In **Colony Fleet**, Susan R. Matthews tells us that a declining Earth will produce a fleet of giant interstellar arks, shaped from asteroids, shepherded by attendant small craft, and sent out on a course to pass by five distant worlds. At each world, the fleet will deposit a colony of Jneers (engineers), Mechs (technicians) and Oways (servants)—an integrated and mutually supportive community. But over the centuries of travel, the groups have become classes—rigidly stratified and mutually resentful. Now Waystation One, the first colonization, looms ahead. The status quo faces its first great challenge.

Meet Hillbrane Harkover. She is a young Jneer facing the test that will admit her to membership in her class. In it,

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each candidate is paired with another, each is given a case to evaluate, and their results are compared to see who is the better Jneer. Long-established custom dictates that candidates leave obvious defects in their analyses; the competition is a gentlemanly pretense, its function one of affirmation and exclusion. But Hillbrane is paired with Raleigh Marquette. They have been lovers; she expects they will be again. But he is a self-centered, scheming twit; he leaves no obvious defect in his analysis to balance hers.

What can the examiners do but bust her down to Mech? Hillbrane's a plucky kid, though; in due time she notices that the Mechs are OK, people who know how to cope, people well worth her allegiance. And in the end, that's what saves the colony.

I leap over a lot of intrigue and argument, difficulties and triumphs, but that's the gist of it. Hillbrane is a very likable and competent heroine. You won't have any trouble at all rooting for her.

Or for Matthews. She is as consistently satisfying as anyone in the field today.

Alan Rodgers seems to be trying something a bit like Stephen King's *Green Mile* serial. **Menace: Battle Mountain** is more, however, than just a chunk of a novel. It is the first installment in a cliffhanger serial that should appeal to old-time *Analog* fans and would surely be as much a hit as *The X-Files* if it ever made it to TV.

Alan tells me that the story is really "Earth conquers the Universe." It began when aliens swooped down on Earth, apparently bent on destroying us all. Fortunately, we're *good* when our backs are up against the wall and we pulled just the right rabbit out of the hat. The result was a repulsed invasion and a landscape littered with the wreckage of their ships and weapons for us to study and adapt.

But the aliens weren't done. *Menace* opens with omens. Then Billy Evans, camping out in the Wyoming mountains, spots an alien ship burrowing into Battle Mountain. He narrowly escapes destruction and flees for town. Meanwhile, a New Zealand amateur astronomer spots a massive fleet heading for Earth. Government agents, flying a Lear souped up with alien tech unraveled by the president's master of efficacy, Macdonald, discover invisible aliens in the air. Secret agents of the aliens prove to infest Congress.

And there we are, our backs against the wall once more, our teeth bared, the aliens' own weaponry in our hands. Macdonald tells the president, "I think we are within hours of an invasion," and here it comes. Fortunately, it seems the aliens don't really know how to wage war, even if their crews are heavily salted with abductees. They're gonna get creamed, and then . . . look out, Universe!

SF fans will find added appeal from the names of major characters: Jane Yolen, David Dvorkin, Ken Estes, and of course, Jim Macdonald.

Here's one more for Terry Pratchett's Discworld: **The Truth**, in which a wordy fellow, William de Worde, who writes a news "letter" (literally) for the nobility, stumbles across a crew of dwarves with a printing press. Before you know it, Ankh-Morpork has its first newspaper, featuring everything from obscenely-shaped vegetables to the latest on the apparent villainy of the city's Boss, Patrician Lord Vetinari, who has been accused of attempted murder.

The reader, of course, knows that Vetinari is innocent, for Pratchett early introduces a remarkable pair of thugs, Mr. Pin and Mr. Tulip (who will snort anything), and their scheme that somehow involves a Vetinari lookalike. And don't forget the talking dog and the sudden competition from the *Ankh-Morpork Inquirer*.

Pratchett as usual has a great deal of fun making fun of our familiar world, especially the tendency of people to be-

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lieve whatever they see in print, freedom of the press, and official resentment thereof. You are therefore likely to have fun as well.

"Science fiction" is a funny term, since it often raises very artificial barriers between itself and the rest of modern fiction. It is easy to find examples of SF that could easily be fitted into the mainstream or mystery genres. It is easy to find "thrillers" and "bestsellers" and "action-adventure" that could as easily be called SF. And once in awhile, we run across strange items such as Christopher Moore's work, which would raise no eyebrows at all if it appeared under, say, the Ace label.

Avon marks the spines of these books just "fiction" and blurbs them as crazed, lunatic, delightfully warped humor. And there is definitely that. But **Island of the Sequined Love Nun** has organleggers and **The Lust Lizard of Melancholy Cove** has a sea monster, and if we wish, we can claim them for our own.

Love Nun begins as drunken pilot Tucker Case, in the throes of inducting a hooker into the Mile-High Club, crashes a pink jet belonging to Mary Jean (empress of the pyramid makeup marketers). He survives, perhaps thanks to a ghostly figure that appears briefly in the cockpit, but his life nosedives worse than the plane. Even before he has recovered from his injuries (one of which is rather bizarre), he loses his job and is off to the South Pacific to fly styrofoam coolers from an island medical mission to Japan. Moore doesn't say what's in the coolers until well after the Astute Reader has twigged, preferring to describe Tucker's romantic surroundings, the Shark People of the island, and their peculiar cargo cult, built around a World War II pilot named Vincent. In due time, everything goes up for grabs and Tucker transforms from drunken loser to hero.

The humor is here, but it is very dark and bleak—a drunken, pratfalling stumblebum, with commentary by talking fruitbat, falls into a tropical Auschwitz. Not quite my cup of tea, even if justice and redemption do prevail.

Lust Lizard suited me much better. The scene is west coast America—Pine Cove—where a rather vapid shrink is impelled by the apparent suicide of one of her patients to take all her patients off meds, replacing them with placebos. The pharmacist—who has a thing for porpoises and even has an anatomically correct inflatable Flipper—is perfectly happy to charge Prozac prices for sugar pills. Meanwhile, pothead constable Theophilus Crowe is a bit grumpy about having to ignore the sheriff's undercover operations, one-time B-movie starlet Molly Michon lives in a trailer and practices her swordwork whenever sanity and meds let her focus, and Steve (the sea monster) awakens from his slumber in the ocean ooze, crawls ashore, and tries to mate with a gasoline tanker in the middle of town. After the resulting explosion, Steve mutters, "All she had to say was No!" and goes off to lick his wounds, turn into a trailer, eat a paperboy, and become Molly's lover.

There's just as much plot as in *Love Nun*—in due time, several kinds of justice prevail—but you get the idea. Moore's humor seems to fit more normally warped scenes better than the world's Auschwitzes.

Gregory Benford is best known for excellent novels such as the recent *Cosm* (reviewed in my June 1998 column), *The Martian Race* (March 2000), and *Eater* (December 2000), as well as for more than two decades of classics, but he is also very good at shorter lengths. If you need convincing, pick up a copy of **Worlds Vast and Various**, which reprints a dozen of his best, beginning with "A Calculus of Desperation," in which biologists rush ahead of an expanding tide of humanity to freeze as many species as possible for the future, even as a strange and highly infective

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virus spreads around the world. The title refers to the kind of math that says if we do nothing, we will see immense loss of human and other life; if we do something that seems brutal now, we may actually—in the long run—save lives.

Some of the other tales collected here are more playful. "Zoomers" is a portrait of work in a world dominated by the info revolution. "Kollapse" shows us how dumb an intelligent, geeky kid can be. The rest—like "A Worm in the Well" (which appeared here in November 1995)—are very much in the hard SF mode, solidly grounded in known science and reasonable extrapolation and given a typical Benford flair.

In my July 1992 column, I praised Nicholas DiChario's "Winterberry"—just his second published story, but quite startlingly excellent in its depiction of a JFK who survived Dallas albeit with his mind reduced to that of a child. The story appeared in *Alternate Kennedys*, edited by the inestimable Mike Resnick, and in the remainder of the nineties, Mike and Nick collaborated on a number of stories for magazines and anthologies. Add a couple more for **Magic Feathers: The Mike & Nick Show**, and you have a double handful of witty, clever, and often cockamamie stories that you are bound to enjoy. Just wait till you try "Fascinatin' Rhythm," whose unemployed musician narrator has a mysterious compulsion to bang things; "Working Stiff," about a king who works as a bus driver; and the quite indescribable "The Fighting 35th's Last Stand at the Dolores Proud Apple Valley School for the Blind." ■

We welcome your letters, which should be sent to Analog, 475 Park Avenue South, New York, NY 10016, or e-mail to **analog@dellmagazines.com**. Space and time make it impossible to print or answer all letters, but please include your mailing address even if you use e-mail. If you don't want your address printed, put it only in the heading of your letter; if you do want it printed, please put your address under your signature. We reserve the right to shorten and copy-edit letters. The e-mail address is for editorial correspondence only—please direct all subscription inquiries to: P. O. Box 54027, Boulder, Co 80322-4033.

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BRASS TACKS

Dear Dr. Schmidt,

I just wanted to comment on Jeffrey Kooistra's Alternate View article regarding Neil Ruzic.

Neil has always been a visionary. He was a founding member of the L5 Society which merged with Werner von Braun's National Space Institute bringing the activists and scientists together to become the National Space Society. Today, Mr. Ruzic actively serves on the NSS Board of Governors.

Neil believes that if we bring enough people together, the grassroots, speaking to the world about living and working in space, we'll be heard. The NSS and Neil want to change the cultural impediments to space development and exploration. To do this, many voices need to be heard giving the same message. Look at the NSS web site (*www.nss.org*) to see who we are. Check out the members of the NSS Boards of Advisors and Governors. You'll find luminaries like Schmidt, Haldeman, Cherryh, Boxleitner, Roddenberry, Hanks, Aldrin, Lovell and many others. They, all, are visionary. Come to the International Space Development Conference in Albuquerque in May and you may get to meet and talk with some of our more illustrious members.

Most of our early members came from the science fiction community but that is no longer true. In fact, one of the most discouraging moments I had was at a party held by a prominent Grand Master of SF and his equally well-known wife. I asked a long-time SF fan to join the NSS and he told me to "keep reality out of his face."

Folks, it's only our reality if we, like Neil Ruzic, work to make it so. Please join the National Space Society and let your voice be heard.

Karen Mermel

Dear Stan,

I just got the Dec. issue today—great editorial! My cousin Eric started gun safety lessons for his kids by taking a watermelon to the range and demonstrating the effect of a small-caliber round at fifteen yards. Impressive stuff!

The current fad for raising children like captive bunnies creates learned helplessness and wild hares, with a low proportion of responsible human beings.

Fran Van Cleave

J. R. Dunn,

You covered the climatic changes in the present interglacial quite well. How about the chances of this current interglacial ending? Previous interglacial warm periods have all been less than 20,000 years in length. In the last half million years, 80% of the time we had continental glaciation, which is normal, not the present warm interglacial.

As for global warming, 90 million years ago crocodilians existed in the Arctic and Antarctic, when the dinosaurs were at their largest and meanest.

If we are to support the world's growing population without massive starvation, we are going to need both global warming and higher atmospheric carbon dioxide, as you pointed out. We need the grapes to come back to Vinland.

In the last 150 years we have multiplied the world population by six times. We have less starvation in the world to-

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day than we had at the turn of the century in 1900.

Your article needs more widespread circulation. Send a copy to Vice President Gore!

Keep up the good work.

David L. Kuck

Dear Stan,

I found the article by J.R. Dunn (Dec, 2000) fascinating, if only because of learning the truth behind the Viking exploration of America beyond what I was taught in grade school ("Leif Erikkson (also called Eric the Red) discovered America" just about sums THAT up).

His historical summary of the effect of known climate changes on was also of interest: even to me, who usually takes no note of history. However, he does seem to completely ignore some key points.

The first one is that he avoids the really controversial issues. As I understand the situation, there is no significant disagreement among those who study such things concerning the existence of the current warming trend. Where the significant (and important) controversy comes in is when you consider the question: "Is any or all of the warming due to human activity?" and I have to consider a discussion of global warming, that does not address or at least acknowledge that question, to be trivial regardless of whatever other interest it may hold.

The second important question, which is partially (but only partially) dependent on the answer to the first is: "Is there anything we can and/or should do about that?"

I suppose that the theme of the article, that global warming is beneficial (unless you're a snowshoe manufacturer or in another industry that is dependent on cold weather), can be taken as an implication that we should not try to reverse the warming trend even if it turns out that we can; but that does not automatically follow as a matter of logic.

Similarly, Mr. Dunn's proposal toward the end of the article that the warming is due to changes in solar radiation also seems to imply that it is purely a natural phenomenon and beyond our control, but first of all that is not proven (as he admits) and second of all it does not mean that we should not try to do something about it if we can.

But none of those really interesting and important points are even mentioned.

Another point that I thought pertinent, but ignored, was the effect on species. Even the beneficial effects of global warming described are only beneficial from the point of view of humanity. That is naturally of paramount importance, but one area that the human race has advanced in recent years is that it considers the effects of various activities (both human and "natural") on other species. While this concern is arguably sometimes overblown, we do generally consider extinction of a species a detriment, and no amount of added agricultural land will resurrect a species once it disappears due to an inability to change fast enough or range far enough to accommodate the changing climate.

So while some of Mr. Dunn's comments appear to peripherally address some of these issues, overall I find myself somewhat disappointed that he didn't consider them all and take them on more directly.

Howard Mark

Dear Stan,

You've mentioned publishing articles to get dialogue going. I'm sure J. R. Dunn's article on global warming will succeed in this respect. Since I'm the person who had fun suggesting in these pages several years back that gamma ray bursters could be the exhaust of alien space ships, I can hardly complain about imaginative science-fact articles. The difference, perhaps, is that nobody is likely to bankrupt the world looking for aliens, but a head-in-the-sand attitude to global warming can do just that.

The evidence for human-caused global

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warming is accumulating daily. Within the scientific establishment, those who disbelieve that evidence are a tiny minority precisely because the evidence is so strong. Just recently, the Intergovernmental Panel on Climate Change issued findings that are chilling, unfortunately only in a figurative sense.

Many of Dunn's references are historical rather than meteorological and none is more recent than 1991, so he appears to have missed all the glaciological, dendrochronological, palynological, and paleontological evidence that has been accumulating in recent years regarding past temperatures. The meteorological literature presents continuously improving climate models that are becoming quite good at predicting change—unfortunately confirming a trend toward global warming.

It seems to me Dunn's argument is that since we haven't had catastrophic climatic change in the last 6,000 years, there is nothing to worry about. He misses the point of the current evidence. It suggests we may be entering the upward bend of an exponential curve. In the last couple of decades, we have consistently and significantly surpassed the hottest periods going back tens of thousands of years. The fact that historically we have been riding the relatively gentle dips and peaks of the flat part of the curve says nothing about our future. The magnitude of the change now being predicted—and likely to occur within a too-fast-to-adjust 100 years—is similar to the depth of the last Ice Age, except in the opposite direction. If mild weather shifts to the Yukon and Siberia within one hundred years, and Iowa becomes a desert, it will not be benign. To argue that we do nothing because we are uncertain of disaster is silly. It is as if one of our Stone Age ancestors agreed that there was a lion a couple of hundred yards downwind and it was looking at him, but he wasn't going to waste energy backing away until he felt its claws. Proof that he was being attacked would then be unequivocal, but the strategy has very poor survival value.

Mia Molvray, Ph. D.

Dear Stan,

The factual article by JR Dunn, "Summer's Lease," that puts the opposing point of view to our doom & gloom environmentalists on the subject of global warming was superb. It should be reprinted and read at loud volume through a megaphone into the deaf ears of the worlds political leaders before they commit some catastrophic error in their misguided attempts to put right a problem that don't need fixing.

I have long thought, as politicians and scientists gloomily forecast the destruction of the world as we know it because of climate change, what about the well known and researched temperature fluctuations that have been occurring since the world began? JR Dunn has assembled a lot of evidence that most of us knew about, and written a coherent article that puts the whole field into clear perspective.

I live in Kent where we have just suffered major flooding, and whilst the trucking industry to which I belong is being crippled by an 80% "environmental" tax on diesel, justified by our greedy government as their efforts to control global warming.

I have purchased *Analog/Asimov* for years purely as a sci-fi fan, but have enjoyed the factuals: I am quite convinced that I have learned more about physics from your pages than I ever learned at school!

Keep up the good work.

Mike Taylor

Dear Mr. Dunn,

Very interesting article of yours in the December *Analog*.

Warming effects greater at higher latitudes could explain the milder weather during the LCO. Temperature differences drive weather patterns; less difference between poles and equator would mean less energy for storms.

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Floods in some areas accompanied by droughts in others is not all that paradoxical. Normally, weather patterns move across the Earth's surface; wet alternates with dry. Now and again, weather patterns freeze in place, sometimes for months or years; areas getting rain keep getting rain, areas getting none continue drying out. Floods and droughts. The prize example of stalled weather is the hurricane that stalled on the coast of Central America a few years ago, pumping massive amounts of rain inland.

Sidney J. Jolly

The author replies:

Quality of evidence erodes rapidly when scientific debates go public. This August, bogus reports of polar ice cap melting overshadowed such developments as an admission by Dr. James Hansen—the man most responsible for the current controversy—that he no longer finds CO_2 warming compelling. Dichotomies in NASA temperature measurements also emerged—while surface readings increased roughly half a degree in 50 years, atmospheric measurements revealed no net change. Those who value scientific method over PR see the case for global warming as not at all clear.

Howard Marks's thoughtful letter mistakes my intent: rather than deal with the controversy as a whole, I aimed to present historical evidence thus far neglected (and neglected is the word—searching the available literature turned up only two vague allusions to the Little Climactic Optimum). Mr. Mark also missed several references to species survival: a detailed examination of agricultural species and a footnote on marine coral. I agree that the subject (along with every other aspect of the LCO) merits more research.

Standards of evidence get an impressive workout from Mia Molvray. Since James Wiebe mentioned the Oregon Petition Project (http://www.oism.org.pproject) in "Brass Tacks" last summer, no *Analog* reader has any business asserting that only a "tiny minority" of scientists doubts global warming. The petition's 17,000 signatures represent nearly one-fifth the working scientists in this country, a minority by no means negligible. Similarly unmentioned is severe methodological criticism of the IPCC report (covered at http://www.sepp.org/ipccont). The alleged vast array of climatological research on the LCO is dealt with above. The sole relevant dendrochronological study appeared after my article's submission, and makes claims only for the past millennium, not "tens of thousands of years". Finally, Ms. Molvray exhibits a common confusion between evidence and speculation. The historical record is evidence, meriting serious consideration. Visions of greenhouse cliffs and desert Iowas are speculation, with no corroborative standing. (At the risk of appearing ruthless, I'll add that the first suggestion of anomalous gamma-ray sources as starship exhaust appeared in an article by Ben Bova in one of the earliest *Analog* issues I ever read, circa 1968).

Mike Taylor's letter is a stark reminder of what may be in store. Britain's deteriorating weather—"the worst floods in fifty years"—matches no accepted warming model, while hauntingly recalling the fate of Winchelsea in 1297. Similar storms have struck Italy, Japan, Sweden, and California in recent weeks. As I write in late November, Buffalo is digging out from under two feet of "unseasonable" snow, while outside my window the temperature has dropped to the 20s for the fifth straight day. It's difficult to see Manhattan palm trees in any of this, far easier to discern the famine, plagues, and misery that wrecked medieval civilization. We know far more today than they did in the 14th century, though not as much, perhaps, as we think. Do we know enough?

I thank David L. Kuck and also Sidney Jolly for detailing the exact mechanism of weather melioration during warming episodes.

JR Dunn ■

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UPCOMING EVENTS Anthony Lewis

25–28 May 2001
WORLD HORROR CONVENTION at Seattle Marriott Sea-Tac Airport, Seattle, WA. Guests of Honor—Richard Laymon, Simon Clark; Editor Guest of Honor—Jessica Amanda Salmonson; Publisher Guests of Honor—Barbara & Christopher Roden; Artist Guest of Honor—Charles Vess; TM—Jack Ketchum. Registration—$90 until 15 November 2000, then more. Info—World Horror Convention: Seattle 2001, Box 5171, Bellingham WA 98227; phone—(360)734-0919; e-mail—<whc2001@uswest.net>

29 June–1 July 2001
CONSORTIUM (Houston area SF conference) at Radisson Hotel & Conference Center Hobby Airport, Houston TX. Guest of Honor—David Weber; Fan Guests of Honor—Margaret Fincannon and Clif Davis; MC—Tony Elam. Registration—$25 until 31 May 2001, $30 thereafter. Info—ConSortium 2001, Private Mail Box 367, 3118 Farm 528 Rd, Webster TX 77598; email—<info@consortium.org> URL—<www.consortium.org>

5–8 July 2001
WESTERCON 54 (West coast science-fantasy conference) at DoubleTree Hotel Jantzen Beach/DoubleTree Hotel Columbia River, Portland OR. Guest of Honor—Tim Powers; Artist Guest of Honor—Frank Lurz; Editor Guest of Honor—Terri Windling; Fan Guest of Honor—Mike Glyer. Locus Awards will be presented. Info—Westercon 54, Box 5901, Portland OR 97228-5901; phone—(360)993-2001; email—<deaner@pacifier.com> URL—<www.osfci.org/w2001>

30 August–3 September 2001
MILLENNIUM PHILCON (59th World Science Fiction Convention) at Philadelphia Marriott, Philadelphia, PA. Guests of Honor—Greg Bear, Stephen Youll, Gardner Dozois, George Scithers, TM—Esther Friesner. Registration—$160 after 30 September 2000; supporting $40. (These are the latest rates posted on the Internet as of the time this column went to press.) This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—Philcon, Box 310, Huntingdon Valley, PA 19006. email—<philcon2001@netaxs.com> URL—<http://www.netaxs.com/~phil2001>.

26–29 October 2001
WORLD FANTASY CONVENTION 28 at Montreal, Quebec. Registration—$90 until 15 October 2000 (latest information at press time). Info—2001 WFC, c/o Bruce Farr, 7002 North Sixth Avenue, Phoenix, AZ 85021, USA, phone—(602)395-1945; email—<brucex.farr@intel.com>

Convention runners: If your convention has a telephone, FAX, email, or web page URL, please let us know so that we can publish this information.

Convention attendees: When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an IRC if the convention is in a different country. ■

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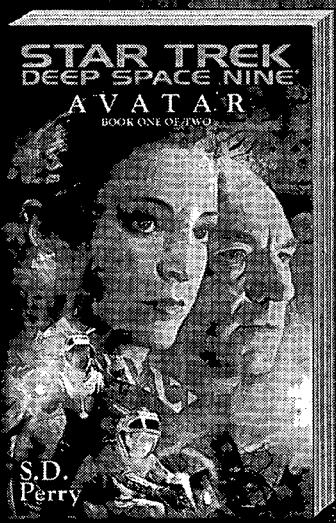

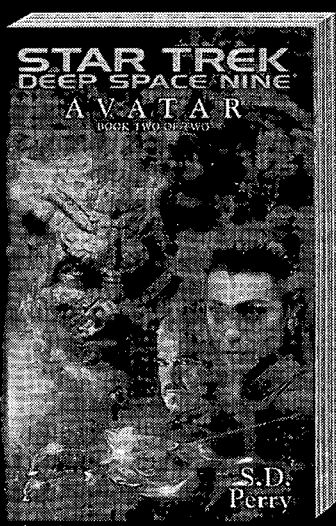

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